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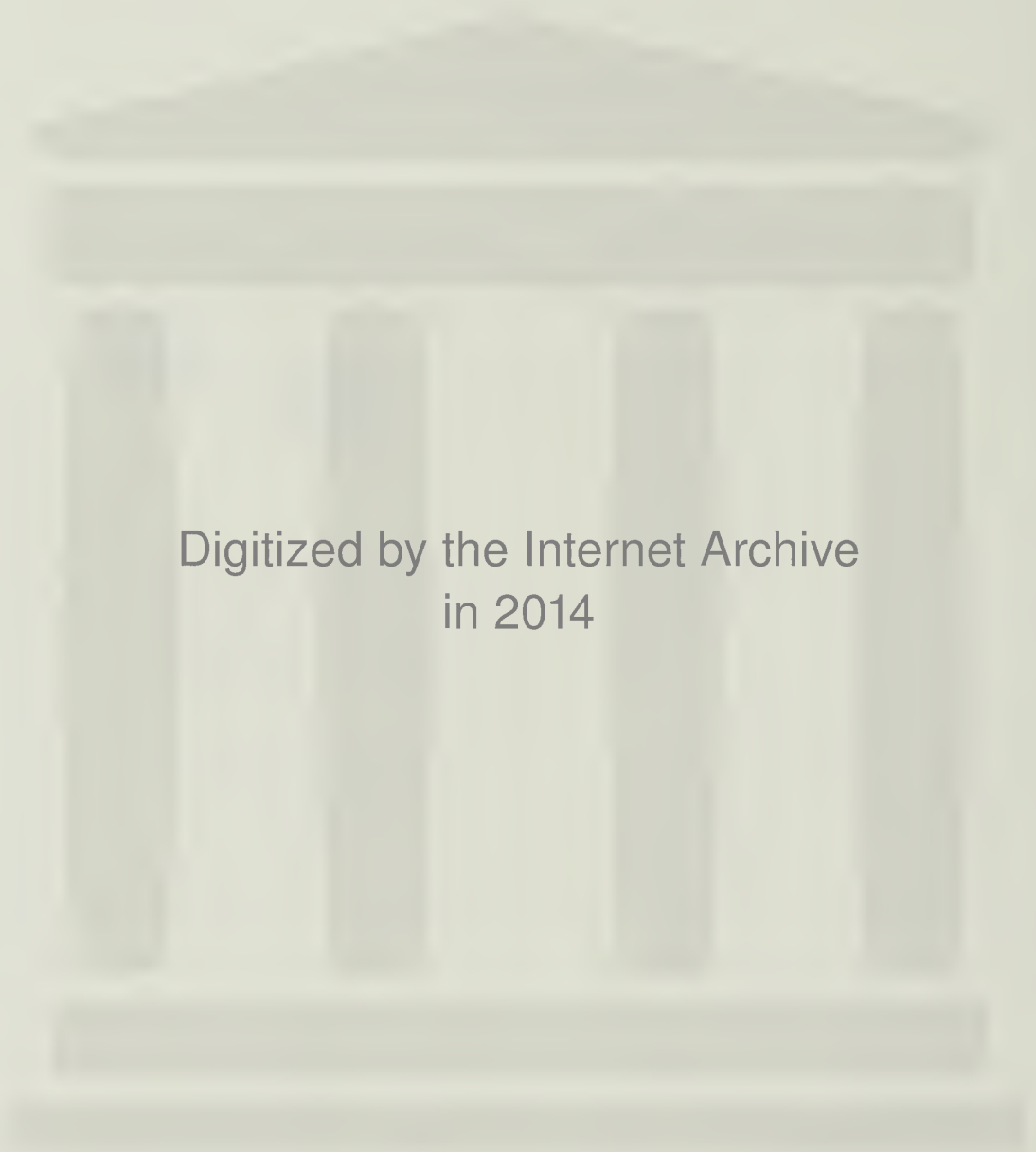
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ENVIRONMENTAL IMPACTS

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CHAPTER V
ENVIRONMENTAL IMPACTS

This chapter presents potential environmental impacts of the Recycled Water Master Plan (RWMP) and the Groundwater Master Plan (GWMP). All impacts associated with the RWMP are discussed in the first part of the chapter, followed by a discussion of all impacts associated with the GWMP, although within each section any cumulative effects associated with implementation of both plans are discussed. Cumulative effects associated with growth inducement of both the RWMP and GWMP are discussed in Chapter VI.

A. RECYCLED WATER MASTER PLAN

A.1 LAND USE AND VISUAL

INTRODUCTION

This discussion of impacts is organized by facility project sites: RWTP, Lincoln Reservoir, McLaren Park Reservoir, and transmission and distribution pipelines.

Land use impacts would occur if the project divided the physical arrangement of the area, or substantially affected the existing character of the vicinity in such a way as to permanently disrupt or displace existing land uses. Visual impacts would occur if scenic views, scenic resources or visual character were substantially disrupted.

Recycled Water Treatment Plant - Fleishhacker Pool Site

Land Use

The Fleishhacker RWTP site is located in the northwestern corner of the grounds of the San Francisco Zoological Gardens (see Figure 36, p. 118). This is the site of the former Fleishhacker Pool and Bath House. The pool is now filled in and paved and the Bath House is still standing but has been out of use since the mid 1970s. Portions of the site are used for employee parking and for staging of on-going zoo projects, though much of the site is often not actively in use.

During the anticipated 24-month RWTP construction period, about 5 to 7 acres of the Fleishhacker Pool and Bath House area would be occupied with construction activities and materials storage. The RWTP construction activities would displace other uses of the site for the

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duration of the construction. Therefore, for about 24 months, the staging area and RWTP site would not be available for employee parking, for Zoo materials storage, or for staging of ongoing Zoo projects. However, the construction and staging would only take about one half of the paved Fleishhacker Pool and Bath House area between the Zoo and Highway 1. The southern end of the paved area, 50 to 100 feet south of the RWTP site would remain open and available for these uses. Because this paved area is not normally entirely occupied, consolidation of current uses onto the southern end of the paved area during construction would not substantially compromise the concurrent use of the site for employee parking and Zoo staging. Following completion of construction activities, the RWTP would occupy about three acres and the remainder of the site would again be available for Zoo uses as necessary.

The Fleishhacker RWTP site property is owned by the City and County of San Francisco and is managed through a partnership between the San Francisco Recreation and Park Department and the not-for-profit San Francisco Zoological Society.[1] The site is a zoned "P" - Public Use District. Construction of the RWTP facilities on the site would permanently convert a portion of this area to public utility use. However, the underground portions of the RWTP facilities have been designed to accommodate joint use with the other uses proposed by the Zoo for this area.

In particular, location and design of the RWTP facilities has been coordinated with the location and design of proposed Zoo Master Plan and Zoo Infrastructure Master Plan facilities to ensure viable joint use of the site. The final RWTP facility area would cover about three acres, about one third above ground, and two thirds below ground. Above ground facilities would be located within the footprint of the former Bath House. The remainder of the facilities, the equalization storage facility and the clearwell storage facility, would be constructed underground within the paved former pool area. Construction of the equalization storage and clearwell facilities below ground would be designed to accommodate loads which would allow the Zoo to develop the area with a new entry plaza and visitor parking area proposed in its Master Plan, as shown on Figure 38 (p. 122). In addition, the design of the RWTP facilities has been coordinated with Zoo Infrastructure Master Plan proposal for a new groundwater reservoir in the northern portion of the Fleishhacker Pool and Bath House area.

The vicinity of the Fleishhacker Pool and Bath House area could experience cumulative construction land use effects (temporary displacement of on-site and adjacent uses for construction and staging) due to closely scheduled or simultaneous construction of the RWTP

1 San Francisco Zoological Society, *San Francisco Zoological Gardens Master Plan Report Manual,* June 1994.

along with Zoo infrastructure improvements and Zoo Master Plan projects in and around the Fleishhacker Pool site. However, as discussed above, construction of RWTP facilities has been closely coordinated with these other proposed activities, and no substantial conflicts are anticipated. All of the proposed Zoo infrastructure work adjacent to the RWTP site, including replacement of the utility line corridor adjacent to the RWTP site, construction of the nearby wet-weather lift station and groundwater wells, and construction of the groundwater reservoir is scheduled to occur prior to the start of the RWTP construction (see construction schedule, Figure 39, p. 123).

The new Avian Conservation Center (ACC), located about 1,200 feet from the RWTP site, was completed in the fall of 1996. All of the ACC birds currently located in the existing facility between the Children's Petting Zoo and the Musk Ox Meadow, adjacent to the Fleishhacker Pool and Bath House, will be relocated to the new center prior to commencement of any RWTP construction activities. The new ACC is sufficient distance from the RWTP and separated from it by a vegetated berm such that the construction activities would not be noticeable. Therefore, completion of the new ACC and relocation of associated animals and activities (breeding, management and study of birds, including rare and endangered species) prior to RWTP construction would prevent impacts to these sensitive species.

Proposed Zoo Master Plan projects, including development of a new Zoo entry plaza, providing vehicle access from the Great Highway, and visitor parking on the Fleishhacker Pool site, would begin after plant construction begins in 1999 and could overlap with the proposed RWTP construction period. Overlap in construction could increase the amount of area occupied with staging at one time, temporarily increasing the displacement of current employee parking and zoo staging uses.

Increased noise, dust, and truck traffic associated with construction, (and to a lesser degree, with operation) of the RWTP could disrupt adjacent land uses, primarily Zoo visitors, employees and animals and possibly the residences proposed for development across the street from the site at the corner of Sloat Boulevard and the Great Highway. Potential disruption of adjacent land uses due to noise, dust, and traffic is discussed in the relevant sections of this document.

In conclusion, if all current plans for the area are ultimately developed, the Fleishhacker Pool and Bath House area would ultimately be mixed use, including the treatment plant, Zoo entry and parking, and groundwater reservoir, surrounded by residential uses, the Zoo, the Westside Pump Station and The Great Highway and Ocean Beach. The above-ground components of the

treatment plant would occupy about one acre of the three acre site. That one acre portion of the site, while still in pubic use, would no longer be available for potential public recreational use. Nevertheless, the overall character of the site and surrounding area would not change substantially, i.e., a mix of public uses (primarily Zoo, with some public works facilities) surrounded by residential development and Ocean Beach. The underground portions of the proposed RWTP would accommodate the facilities proposed in the Zoo Master Plan and Infrastructure Master Plan. Hence, the proposed RWTP facilities would not conflict with the existing or proposed uses of the site by the Zoo.

Zoning

The San Francisco Planning Commission would review the project for consistency with Local Coastal Program and issue a Coastal Development Permit, in accordance with Section 30412 of the California Coastal Act of 1976. The Recreation and Park Commission must make a determination that use of the Fleishhacker Pool and Bath House site for a RWTP would be consistent with recreational use of the site. If the Commission determines the use is not consistent, then under the City Charter, voter approval would be required to allow such use on the site.

Visual

During RWTP construction, the excavation, materials storage and other construction activities would temporarily change the visual character of the Fleishhacker Pool and Bath House site. However, the Fleishhacker Pool and Bath House site is currently almost completely screened from view by landscaping between the Zoo and the site, a fence and vegetated berm along Sloat Boulevard, the Westside Pump Station, the abandoned Bath House, vegetation along the Great Highway, and a vegetated berm and the Oceanside Water Pollution Control Plant (WPCP) on the south end. RWTP construction activities would not be visible from most points around the site perimeter. On-site activities would not be visible from the existing residences a block away on Wawona Street, due to their distance from the narrow viewpoint.

Limited views of the construction activity could occur from the Great Highway and beach-front area during construction within the Bath House area; and from Sloat Boulevard through the fence across the access driveway. In addition, if the proposed residential project at 2900 Sloat Boulevard on the corner of Great Highway is approved and constructed, the Fleishhacker Pool

site may be visible from top floor units, although views would be obstructed by the on-site berm and dense landscaping.

Once construction is complete, the RWTP facilities would not appreciably change the existing views or aesthetics of the site. About two thirds of the proposed facility area would be buried below ground, and would therefore not be visible once complete. The surface at the proposed equalization storage and clearwell facility site is currently flat and paved and would be so again once construction was complete. Above-ground RWTP facilities would have approximately the same dimensions and location as the former Fleishhacker Bath House. These above ground facilities would therefore allow approximately the same views of and from the site and would provide a similar sense of developed area. In terms of architecture and appearance, the Bath House building, as described above at p. 254, would be replace by a new structure. Architectural design treatment of the above-ground RWTP facilities has not yet been determined.

Lincoln High School Reservoir Site and McCoppin Square Staging Area

Land Use

The Lincoln High School Reservoir site is located on the high school football field, and it is surrounded by school buildings, open space, and residential uses (see Figure 41, p. 131). The nearest residences are about 100 feet from the site, across 22nd Avenue from the school.

The Lincoln High School football field is used for football in the winter, track in the spring, and for Physical Education classes during the school day all school year. In addition, class assemblies and rallies are held periodically on the field. During the eight-month construction period for the Lincoln reservoir, the school's football stadium would be occupied with construction activities and would be unavailable for any of these existing uses. The Department of Public Works would work with the School District to find alternative means of accommodating the school's needs during construction (see Chapter VII, Mitigation Measures A-1 and A-2). For example, there is an unused field adjacent to the football field that could be improved to temporarily accommodate some sports and assembly activities. Additionally, the school has two indoor gymnasiums and outdoor tennis and basketball courts. Some of the school's activities could also be consolidated on the school's paved play area above the football field to the north. In addition, students could potentially be bused to alternative field sites for sports activities during the construction period.

Construction of the proposed reservoir would permanently convert a portion of the area to public utility use. However, the majority of the facilities would be below ground and would accommodate joint use with other existing and planned uses. Once constructed, the reservoir would be completely buried underground and the site would return to its previous uses. The football field would be regraded and resurfaced to restore the track and turf. The pump station and altitude valve vault would be located mainly below ground, though a 20-foot by 60-foot portion of the structure, 15-feet high with landscaping would remain above ground between the football stadium perimeter wall and Santiago Street for access to the underground facilities. This site is currently a landscaped area. The operation of the reservoir would not affect any of the uses of the site or surrounding area. Periodic maintenance activities would occur at the altitude valve vault and pump station. The vault and pump station would be accessed from Santiago Road and would require no disruption of adjacent school uses.

The McCoppin Square Park staging area would include Santiago Street and the northern end of McCoppin Square Park, between 22nd and 24th avenues. The staging area lies between a baseball field at the north end of McCoppin Square Park and the Lincoln High School reservoir site (see Figure 41, p. 131). The nearest residences lie about 100 feet away on 22nd and 24th Avenues. During the estimated 8-month construction period for the Lincoln High School reservoir, the staging area would be occupied with construction materials, vehicles and staging activity and would be unavailable for its existing uses. Santiago Street and the sidewalks would be closed to vehicle and pedestrian traffic. Vehicle circulation and access issues are discussed in Section V.A.7, Traffic, p. 314.

The level grassy area at the northern end of McCoppin Square Park would not be available for park / public open space uses. Use of this approximately one-acre grassy area for staging would not displace any structured recreational activities. The adjacent baseball field would remain open and accessible to the public during construction. Following construction completion, the staging area would be returned to its original condition; any affected vegetation and grade would be restored and the site would accommodate all previous land uses.

Increased noise, dust, and truck traffic associated with construction of the reservoir could disrupt adjacent land uses, primarily the high school, McCoppin Park visitors, and the residences on 22nd Avenue adjacent to the site. Potential disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

Zoning

Use of the Lincoln High School football field for underground reservoir operation and of McCoppin Square Park site for construction staging would be consistent with the P (Public Use) zoning for each site.

Visual

Construction at Lincoln High School in the football field area would be visible on campus but would be screened from the view of adjacent and nearby residents by the cement wall / bleachers surrounding the field. Unobstructed views of construction activities and staging would be available from the baseball field at McCoppin Park, and from the intersections of Santiago Street and 22nd and 24th avenues on either side of the staging area. For the eight-month construction period, views of Santiago Street and adjacent vegetated sidewalk areas would be replaced with views of construction materials and activities. Once construction is completed, however, any affected grade or vegetation would be restored. There would be no permanent impacts to views or visual quality at the reservoir site or staging area. The new partially above ground concrete valve vault would be visible from Santiago Street as a doorway access to underground facilities and would be seen together with the wall and vegetation surrounding the school. Landscaping would be planted around the valve vault to mitigate the visual impact of the structure (see Chapter VII, Mitigation Measure A-3). See also Biological Resources, below, pp. 371 to 372, for further discussion of potential impacts to existing vegetation.

McLaren Park Reservoir Sites 1 and 2

Land Use

McLaren Park Reservoir Site 1 would span Shelley Drive and the Upper Reservoir parking area, as well as some of the surrounding open space (see Figure 43, p. 135). Surrounding land uses include park open space, the Upper Reservoir, about 50 feet from the site, and residences at the end of Prague Street, about 250 feet from the site.

If the reservoir is located at Site 1, the parking lot adjacent to Upper Reservoir, portions of Shelley Drive, and surrounding park areas (a total of about 2.5 acres) would be occupied with construction activity and staging for the estimated twelve-month construction period. A portion of Shelley Drive and the Upper Reservoir parking area would be closed during construction; traffic impacts are discussed in Section V.A.7, Traffic, p. 314. Pedestrian paths would be

relocated around the construction site. Picnic areas at the Upper Reservoir, and picnic and play areas west of the site on Shelley Road would remain open during construction. During construction, park visitors would most likely relocate to other picnic areas and walking paths in the park.

Construction of the proposed reservoir would permanently convert a portion of the park area to public utility use. However, the majority of the facilities would be below ground and would accommodate joint use with other existing and planned uses. Following reservoir construction at McLaren Park Site 1, the reservoir would be completely buried and the surface use would be restored to its prior condition except for an at-grade access hatch to the concrete altitude valve vault. The road, parking area, and the pedestrian paths would be repaved, and the grass-covered slopes would be returned to their original grade and reseeded. The vegetated strips around the parking area would be re-planted. None of the site's existing uses would be affected by operation of an underground reservoir at the site.

McLaren Park Site 2 is located in park open space adjacent to the intersection of Mansell Road and Shelley Drive. Several dirt paths used by walkers and joggers cross over and adjacent to the site. The site is surrounded by park open space, and is about 1,100 feet from the nearest residences. During construction, an area of about 3.5 acres would be used for construction activity and staging. This area would be unavailable for the current land uses; pedestrian paths would be relocated around the site for the construction period.

Similar to the reservoir at Site 1, construction of the proposed reservoir would permanently convert a portion of these public use areas to public utility. However, the majority of the facilities would be below ground and would accommodate joint use with other existing and planned uses. Once the reservoir at Site 2 is complete, the site would be returned to its original condition and use except for an at-grade access hatch to the concrete altitude valve vault. The reservoirs would be completely below ground, and disturbed slopes would be regraded to near-original contours. The area would be reseeded, any affected vegetation would be replaced, and the dirt paths would be restored to original or better condition. See also Biological Resources, below, pp. 372 to 373, for further discussion of potential impacts to existing vegetation. Existing use of the site for walking and jogging would not be affected by long-term operation of a reservoir at the site. A McLaren Park visitor center has been proposed in the Park Master Plan in the vicinity of Site 2. The Recreation and Park Department has not yet developed specific plans or a schedule for this center. The final design of the reservoir at Site 2 would be coordinated

with the Recreation and Park Department in order to maintain the option of joint use of the site for a future visitor center with the reservoir.

Increased noise, dust, and truck traffic associated with construction of the reservoir would disrupt adjacent land uses at Sites 1 or 2. At Site 1, the land uses that would most likely be affected would be the residences west and northwest of the site, visitors to the Upper Reservoir, and other park visitors walking or jogging near the site. At Site 2, the land uses that would most likely be affected would be park visitors walking or jogging near the site. Disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

Zoning

The Recreation and Park Commission must make a determination that use of McLaren Park for a reservoir would be consistent with recreational use of the site, If the Commission determines the use would not be consistent, then according to the City Charter, voter approval would be required to allow such use on the site.

Visual

Unobstructed views of McLaren Park Site 1 reservoir construction would be available from the park visitors on adjacent paths, from the Upper Reservoir area, and from the backs of houses at the end of Prague Street. Unobstructed views of McLaren Park Site 2 construction would be available from Shelley Drive, Mansell Road, and from adjacent park paths. Existing views of a grass-covered slope, road, and parking area at Site 1, or of grass-covered slopes at Site 2 would be replaced by views of construction activity and staging for an estimated twelve months. Following construction completion, however, the site would be regraded to near-original contours and revegetated. Operation of a reservoir at either site would not alter the site's visual character or surrounding views.

Transmission and Distribution Pipelines

Land Use

Construction of the proposed pipelines to transport recycled water to the storage reservoirs and to deliver it to the users would result in short-term in-street disruption (see Traffic Impacts

section V.A.7). In general, there would be no short-term or permanent displacement of land use, since pipelines would generally be located within roadway rights-of-way.

The Phase 1 transmission pipeline from the RWTP to the Lincoln reservoir site and 19th Avenue AWSS connection would run alongside the San Francisco Zoological Gardens and mixed commercial and residential land uses for two blocks on Sloat Boulevard, and through mainly residential uses along the remainder of its route along 45th Avenue and Santiago Street to the site between 24th and 22nd avenues.

As mentioned above in the Project Description, specific alignments of transmission and distribution pipelines for subsequent phases of the RWMP have not yet been determined. However, in general, the remaining transmission and distribution pipeline corridors required for the RWMP would extend through a variety of San Francisco districts including the Outer Richmond, Golden Gate Park, Outer Sunset, Parkside, Lakeshore, Ocean View, Outer Mission, Excelsior, Visitacion Valley, and Bayview districts. The pipelines would extend primarily through residential areas, and, to a lesser degree, through areas of commercial and public uses, including school, Zoo, and park uses.

Operation of pipelines would cause no permanent displacement of land uses along any route, because the pipelines would be constructed below grade in public streets and the routes would be restored to pre-existing contours, cover and use once construction is complete. Construction of pipelines would cause temporary, localized traffic disruption (see Traffic Impacts, p. 320) but would not constitute a permanent adverse land use impact.

Increased noise, dust, and truck traffic associated with pipeline construction could disrupt land uses adjacent to each site, including nearby school uses, residences, and businesses. Disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

A.2 GROUNDWATER AND SURFACE WATER RESOURCES

Introduction

The following impact analysis is organized by long-term impacts followed by construction impacts. Potential long-term impacts of the RWMP are discussed by issue rather than by project site, since effects on the ground and surface water resources would generally be on a systemwide basis. These impacts are analyzed at a more general, program level. The section on construction impacts is organized by project sites, and impacts are analyzed on a project-level basis.

Over the long-term implementation of the RWMP, use of recycled water would have the potential to affect groundwater and surface water resources, with respect to water quality or water balance, predominantly through its use for irrigation. As irrigation water, recycled water would have water quality implications for effects on public health, vegetation, and groundwater and surface water quality; it could also affect the groundwater balance. Public health impacts associated with human exposure to recycled water are discussed in the next section of this report under Public Health and Water Quality, pp. 273 to 292. Potential effects of recycled water on vegetation are discussed under Biological Resources, pp. 363 to 373. This section discusses the potential long-term effects of recycled water on groundwater quality, groundwater balance, and surface water quality. In addition, this section discusses the potential short-term effects on groundwater associated with dewatering activities during construction of the RWMP facilities,

Groundwater Quality

The RWMP identifies landscape irrigation as the largest percentage (72%) of proposed recycled water use in the City. Throughout the entire City, there is a projected average annual demand of about 7 million gallons daily (mgd) for recycled water for use in landscape irrigation. The major irrigation users would be: Golden Gate Park, the Presidio, McLaren Park, Lincoln Park, the San Francisco Zoo, and the parks and golf courses near Lake Merced. Currently, these users are using either groundwater or potable City water (San Francisco Water Department water or SFWD water) to irrigate their grounds. Implementation of the RWMP would replace the current irrigation water supply source with recycled water, which would represent a change in quality. Application of recycled water to landscape areas at rates exceeding the irrigation requirements could potentially result in leaching of constituents in the recycled water to the groundwater beneath and downgradient of each of the irrigation sites. However, adverse effects on groundwater quality would not be expected, as discussed below.

Generally, irrigation water is applied to the ground surface at an appropriate rate to satisfy plant water needs. However, the water that is not taken up by plants (or evaporated) infiltrates to the upper layers of soil where water can be stored above the level of the groundwater table. Depending on the amount of irrigation water applied, some of the water (and the dissolved constituents in it) can eventually percolate through the soil column and eventually to the groundwater. Once the irrigation water reaches the water table, it becomes part of the groundwater system.

If recycled water is used to replace groundwater or imported surface water for irrigation, the constituents in recycled water that are typically of concern to groundwater quality include salts (usually represented as total dissolved solids or electrical conductivity), metals and nitrate. Any of these constituents, if not adsorbed (chemically bound) by soils or taken up by plants, could leach through the root zone and infiltrate through the soil and possibly percolate to the groundwater table. Bacterial constituents, such as coliform, would not be a concern because the recycled water would be disinfected to reduce coliform levels to meet Title 22 standards. Table 25 presents a comparison of water quality of the proposed recycled water, groundwater from the Elk Glen irrigation well in Golden Gate Park, and SFWD water.

The table indicates that with respect to total dissolved solids, the projected recycled water quality would be comparable to the groundwater quality (394 compared to 350 mg/L, respectively), and projected level of total dissolved solids in recycled water is well below the secondary drinking water standard of 500 mg/L. The concentration of total dissolved solids, however, would be about six times higher than the SFWD water. The SFWD water is an exceptionally pure water since the majority of it originates as snowmelt in the Sierra Nevada mountains (see Chapter II, p. 18). Even though the concentration of total dissolved solids in the recycled water would be similar to that present in the groundwater in the Elk Glen Well, the distribution of ions would be different. For example, chloride and nitrate concentrations in the recycled water would be higher than levels in groundwater, but calcium, magnesium, and sodium levels would be lower. Nevertheless, overall increases in total dissolved solids in groundwater due to landscape irrigation with recycled water would not be expected assuming that the recycled water irrigation users are now supplied by groundwater.

Levels of metals in recycled water would not be expected to affect groundwater quality. Most dissolved metals in irrigation water would adsorb to the soil due to the chemical properties of soil and would not likely infiltrate to the water table. In addition, as noted in Table 25,

TABLE 25: COMPARISON OF RECYCLED WATER AND GROUNDWATER QUALITY
(all units mg/L unless otherwise noted)

Parameter	Projected Recycled Water /a/	Elk Glen Well Groundwater /b/	SFWD Drinking Water /c/
Total Dissolved Solids	394	350	61
Specific Conductance, umho/cm	690	570	101
pH, units	7.8	7.7	8.6
Total Coliform, MPN/100 ml	<2.2	<2	0.7
Turbidity, NTU	<2	<1	0.2
Odor Threshold, units	no data	<1	<1
Calcium	15.2	399	24
Magnesium	11.6	425	10
Sodium	110.2	307	9.1
Potassium	14.0	no data	0.5
Chloride	146	38	12.9
Hardness	110	234	33
Boron	0.49	0.042*	0.058*
Ammonia-Nitrogen	13	no data	no data
Nitrate	62	10.4	0.46
Arsenic	<0.0050	<0.002	0.001
Cadmium	<0.0020	<0.01	<0.001
Chromium, Total	<0.010	0.024	<0.001
Copper	0.0104	<0.001	<0.001
Iron	0.127	<0.05	0.112
Lead	<0.0030	<0.001	<0.001
Manganese	0.027	<0.005	0.009
Mercury	<0.00020	<0.0002	<0.001
Nickel	<0.020	no data	0.002
Selenium	<0.0050	<0.001	<0.002
Silver	<0.010	<0.02	<0.001
Zinc	0.037	no data	<0.005

/a/ Projected Recycled Water quality based average of data collected between February and August 1995 at Oceanside Water Pollution Control Plant which represent dry weather, coliform, turbidity and pH are projected values based on proposed treatment processes at the RWTP. Source: City and County of San Francisco, *Recycled Water Master Plan*, July 1996.

/b/ Elk Glen Well, located in Golden Gate Park, samples collected by SFWD 11/3/93. Groundwater pumped from deep aquifer >170 feet below ground surface.

/c/ SFWD Drinking Water is represented by San Francisco Water Department 1994 Annual Water Quality Report, average values. Not all parameters shown. About 85% from Hetch Hetchy, 15% from local watersheds.

* Boron data collected during Landscape Irrigation Pilot Study, October 1993 to April 1994.

MPN = Most Probable Number; NTU = Nephelometric Turbidity Unit; umho/cm = micromho per centimeter

concentrations of most metals (arsenic, cadmium, chromium, iron, lead, mercury, nickel, selenium, and silver) are comparable in the projected water quality and the groundwater or SFWD water. Although levels of copper, manganese and zinc in the recycled water appear to be about ten times higher than in the groundwater or SFWD water, the levels of all metals measured in recycled water are well below the applicable drinking water standard (see Public Health and Water Quality, Table 26, p. 274). Boron, unlike other metals, is not readily adsorbed by soils. The projected boron concentration in recycled water is 0.49 mg/L compared to 0.042 and 0.058 mg/L for groundwater and SFWD water, respectively. There is a potential for the recycled water to increase the level of boron in the groundwater if the irrigation water were to percolate far enough to reach the groundwater table. However, even if the water were to percolate and reach the water table, boron in the groundwater would not be expected to have a public health effect, based on current drinking water regulations. Boron is currently not regulated in California under primary drinking water standards. However, the state has listed a health-based action level of 1.0 mg/L for boron, which is considered as interim guidance for "safe" levels of contaminants in drinking water. The projected level of boron in recycled water would be less than this action level, and therefore would not be considered a public health concern.

As shown in Table 25 (p. 263), the projected nitrate level in the recycled water, based on Oceanside WPCP secondary effluent (since tertiary treatment would not be expected to affect nitrate levels), would be 62 mg/L. This can be compared to the existing groundwater level of 10.4 mg/L and the SFWD drinking water level of 0.46 mg/L. Nitrate in water used for landscape irrigation is a known plant nutrient and is routinely applied to landscaped and turf areas in the form of fertilizer. Nitrogen as nitrate is the form most readily available to plants, and when dissolved in irrigation water, it would be taken up by the plants and provide enhanced plant growth (see Section V.A.10, Biological Resources, p. 363). Therefore, it is unlikely that nitrate from the recycled water would infiltrate and enter the groundwater underlying the various irrigation sites. As evidence in support of this conclusion, a reclaimed water agricultural irrigation project conducted in Tallahassee, Florida found that elevated nitrates were detected in the groundwater; analysis of the nutrient balance of the system indicated that the cause of the nitrates was fertilizer applications to the site rather than reclaimed water.[1] Fertilizers typically contain higher concentrations of nutrients and trace elements than typical recycled water.[2]

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1 Allhands and Overman, *Effects of Municipal Effluent Irrigation on Agricultural Production and Environmental Quality*, 1989. In Camp, Dresser & McKee, Inc., *Guidelines for Water Reuse*, published by Camp, Dresser & McKee, Cambridge, Massachusetts, October 1992.

2 Engineering-Science, *Monterey Wastewater Reclamation Study for Agriculture, Final Report*, prepared for Monterey Regional Water Pollution Control Agency, 1987.

If recycled water is used for irrigation water, it would be necessary for landscape managers to adjust the fertilization practices such that the amount of supplemental nitrogen applied to landscaped and turf areas is lowered to account for higher nitrate loading from irrigation water. In addition, in areas where the underlying groundwater is used for potable water (such as the Westside and Lobos basins), groundwater monitoring may be necessary as further precaution to prevent infiltration of excess nitrate through the soils and entering the groundwater. Nitrate is regulated under the primary drinking water standards with a maximum contaminant level of 45 mg/L required to meet public health standards. Because the projected level of nitrate in recycled water is higher than the maximum contaminant level, inclusion of mitigation measures to manage nitrogen application in the form of fertilizers to landscaped and turf areas and to monitor groundwater potentially used for potable water would minimize the potential for nitrate in recycled water to affect the groundwater (see Chapter VII, Mitigation Measures B-1, B-2 and B-7).

Groundwater Discharge/Recharge

Use of recycled water for landscape irrigation and other uses would reduce the demand for groundwater currently being used to meet these demands. At present, groundwater is being pumped for irrigation and other uses in the Westside, Downtown, Lobos, and South basins, as discussed in Chapter IV.B, Groundwater and Surface Water Resources (p. 148). In the Westside Basin in Golden Gate Park alone, there is approximately 1,140 acre-feet per year of groundwater extraction (see Table 15, p. 160). Under the RWMP, many of these current groundwater users would become recycled water users to meet irrigation or other needs. During Phase 1 of the RWMP, most of the proposed users in the Sunset and Southwest areas are located in the Westside Basin, and groundwater pumping (extraction) would be expected to decrease as recycled water and distribution facilities become available to the users. This, in turn, would affect the current water balance in the basin, since basin recharge would be expected to remain unchanged (since factors affecting recharge would be unchanged). By decreasing the basin pumpage discharge and leaving the basin recharge unchanged, there would be a net increase in either basin storage and/or basin outflow. At this time, it is uncertain whether the decrease in basin pumpage associated with Phase 1 recycled water users would alleviate any reported overdraft conditions in the groundwater basin (such as have been identified in the vicinity south of Lake Merced). The recycled water users would be north and east of Lake Merced, while the overdraft conditions are in the portion of the basin south of Lake Merced. Additional groundwater modeling would be needed to determine the effects, if any, of recycled water use on groundwater overdraft conditions.

Overall, throughout the Westside Basin, recycled water has been identified for the following users currently pumping groundwater: Golden Gate Park, park area near Lake Merced, San Francisco Zoo, and Stern Grove. Although not targeted as recycled water users under the RWMP, there are also golf courses (Olympic Club and San Francisco Golf Course) in the vicinity of Lake Merced which currently pump about 1,000 ac-ft/yr groundwater for irrigation. It is currently being proposed that these golf courses receive irrigation water from Daly City from surface or recycled sources and that groundwater pumping be discontinued. Lake Merced Golf and Country Club, south of the City line in Daly City, is also negotiating a recycled water contract with Daly City. As stated in Section IV.B., Groundwater and Surface Water Setting, Table 15, p. 160, it was estimated that about 3,000 ac-ft/yr of groundwater was being pumped from the Westside Basin for golf course and recreation/park irrigation uses in the early 1990s, including the Olympic Club, San Francisco Golf Course and Lake Merced Golf and Country Club. These users are generally the same users as those proposed for recycled water use plus the three golf courses that are proposed to receive water from Daly City. Thus, about 2,000 ac-ft/yr of groundwater pumpage in the Westside Basin could be replaced by recycled water upon completion of Phase 1 implementation of the RWMP. If the two golf courses also discontinue groundwater pumping and switch to water provided by Daly City, then groundwater pumping in the Westside Basin would decrease by about 3,000 ac-ft/yr. Some groundwater pumping in the Westside Basin, however, would continue, such as proposed future groundwater uses at Golden Gate Park for lakes, daytime watering, leaching and flushing.

Concurrent with implementation of the RWMP, there would be a proposed increase in groundwater extraction in the Westside Basin for potable uses under the GWMP. The total estimated extraction rates for the proposed production wells in the Westside Basin would be about 1,000 ac-ft/yr of groundwater, which includes the Elk Glen Well and the Sunset District wells (refer to Section V.B., GWMP Impacts on Groundwater and Surface Water Resources, pp. 385 to 400). Based on these estimates, the combined long-term effects of the RWMP and GWMP on the water balance of the Westside Basin could be a net reduction in basin groundwater pumpage of about 1,000 ac-ft/yr (assuming that about 2,000 ac-ft/yr of current groundwater pumping would be replace by recycled water). However, it would be necessary to conduct an evaluation of the distribution of basin pumpage to determine whether or not there is an actual net reduction in basin pumpage. Since land use and other factors affecting groundwater recharge are not anticipated to change, only reduction in groundwater pumpage would result in either an increase in storage or an increase in outflow to the ocean.

Similarly, changes in the water budget would be expected in the Lobos Basin, where about 1,000 ac-ft/yr. of recycled water has been identified for non-potable uses at the Presidio, Lincoln Park, and George Washington High School during Phase 1 of the RWMP. (The Presidio overlies both the Marina and Lobos basins, and Lincoln Park overlies both the Lobos and Westside basins.) Current groundwater pumping at the Presidio for non-potable uses is about 200 ac-ft/yr. associated with irrigation at the Presidio Golf Course, which is within the Lobos Basin. Use of recycled water for non-potable uses to replace groundwater currently pumped for this use would result in a reduction of basin discharge by pumping. This in turn would either increase basin storage or basin outflow to the ocean, which could alleviate reported overdraft conditions in the Lobos Basin (see Chapter IV.B, Groundwater and Surface Water Resources, p. 385).

Effects on groundwater discharge would not be as noticeable in the other groundwater basins in the City (Downtown, Marina, Islais Valley, South, and Visitacion Valley basins) compared to the Westside and Lobos basins discussed above. The RWMP would affect the groundwater discharge rate only if recycled water would be used to replace irrigation uses currently using groundwater. This is unlikely in the groundwater basins other than the Westside and Lobos basins for the following reasons. First, recycled water use would be confined to those areas identified as Reclaimed Water Usage areas by City Ordinance 390-91 and 391-91 (see Figure 2, p. 8) which are essentially limited to the Westside, Lobos, Downtown and South basins. Recycled water would not be used in the downtown area to avoid conflicts with the San Francisco Fire Department's Auxiliary Water Supply System, as discussed in Chapter II (p. 24), and use of recycled water in the Downtown Basin would be limited to the Mission Bay area. Second, as discussed in Chapter IV.B, Groundwater and Surface Water Resources (pp. 148 to 181), groundwater extraction is not highly developed in the Marina, Islais Valley, South or Visitacion Valley basins. Therefore, unless there are changes in land use in these areas (such as new parks or golf courses requiring irrigation) and newly identified recycled water uses, long-term use of recycled water as currently proposed under the RWMP would not be expected to affect the water balance in the groundwater system in the Downtown, Marina, Islais Valley, South and Visitacion Valley basins.

Effects on Surface Water Quality

The proposed use of recycled water for landscape irrigation could result in spray or runoff from recycled water entering lakes located throughout the City. The levels of nutrients (primarily nitrogen and phosphorus) in recycled water could then promote unwanted growth of algae in these lakes. At Golden Gate Park, for example, recycled water is proposed for extensive landscape irrigation, and there are several lakes (Stow, Elk Glen, Lloyd, Mallard, Metson,

Spreckels, North, Middle and South lakes) that could be affected by recycled water. Application of recycled water would predominantly be by sprinkler irrigation, as is the current practice in Golden Gate Park, and spray from the sprinklers during normal irrigation and accumulated runoff if there is excess irrigation could enter park lakes or ponds.

Compliance with Water Reuse Requirements to be established by the Regional Water Quality Control Board (RWQCB), however, would minimize the likelihood of this occurrence. In order to implement the RWMP, the City is required to obtain a permit from the RWQCB and to file a detailed Report of Waste Discharge application to the RWQCB for review and consideration of specific water reuse requirements (see Chapter II, pp. 18 to 25 for further discussion). The permit would specify prohibitions for use of recycled water, and it is anticipated that the permit would be based on similar permits recently issued to the cities of Palo Alto and Sunnyvale.[3] The following prohibitions regarding surface runoff would likely be applicable to San Francisco:

- *No reclaimed water used for irrigation shall be applied during periods of rainfall or when soils are saturated such that runoff occurs.*
- *No reclaimed water used for irrigation shall be allowed to escape to areas outside the designated use areas by surface flow or by airborne spray.*

Other typical water reuse requirements designed to protect public health and water quality are described in the next section, V.A.3, RWMP Impacts on Public Health and Water Quality, pp. 273 to 292. The RWQCB water reuse requirements would also include a self-monitoring program and reporting schedule to assure that these prohibitions are enforced. Therefore, no long-term effects on surface water would be expected with implementation of the RWMP.

Construction Impacts

Recycled Water Treatment Plant - Fleishhacker Pool Site

The proposed plan for the RWTP at the Fleishhacker pool site includes two large storage facilities - the equalization and clearwell reservoirs. These structures are planned to have excavation depths of 6 to 10 feet, and therefore would require site dewatering during excavation and foundation work since the groundwater table would likely be encountered approximately one foot below the surface. At this time, permanent dewatering wells are not anticipated for the RWTP. As part of construction monitoring under the Department of Public Works, Bureau of

[3] Allen, Blair, Associate Water Resources Control Engineer, Regional Water Quality Control Board, telephone communication with Joyce Hsiao, Orion Environmental Associates, dated April 10, 1995.

Construction Management, groundwater levels and groundwater quality in the vicinity of the site would be monitored on a regular basis (before, during and after dewatering activities) for potential effects on the nearby Zoo wells, as discussed below. Depending on the quality of the groundwater, disposal of dewatering discharge would be either to the combined sewer system, subject to the requirements of the Industrial Waste Ordinance (Article 4.1 of the San Francisco Public Works Code), or directly to the ocean or Lake Merced, subject to the approval of the Regional Water Quality Control Board (see Chapter VII, Mitigation Measure B-5).

Dewatering for construction of the RWTP may affect the performance of the Zoo wells located approximately 240 feet northeast of the proposed site of the equalization tanks and could promote the migration of the saltwater/freshwater interface eastward toward the vicinity of the Zoo wells. The magnitude of these effects would depend on the duration and extent of dewatering required for excavation and foundation work.

Potential effects on the Zoo wells can be predicted based on monitoring done during dewatering activities conducted in 1992-1993 for construction of the Lake Merced Transport project. The Lake Merced Transport project was construction of a 13.5-foot diameter wastewater tunnel under the Great Highway from Sloat Boulevard to Skyline Boulevard and required groundwater extraction to a depth of 30 to 35 feet below surface along the tunnel alignment. Water levels in an observation well at the Fleishhacker site, located just east of the Westside Pump Station berm, were observed to drop to -8.7 feet msl during the year-long dewatering period, equivalent to approximately 15.7 feet of drawdown below surface. Dewatering wells along the tunnel alignment in the Great Highway were contaminated with saltwater within three months of pumping as the saltwater/freshwater interface was pulled landward by the dewatering pumps. During the dewatering period for the Lake Merced Transport project, water quality monitoring of the Zoo wells (200-feet deep) and the deep aquifer (greater than 100 feet deep) showed no change in chloride levels, a water quality constituent used to indicate the presence of saline contamination. Although saltwater intrusion occurred in the shallow aquifer approximately 480 feet west of the Zoo wells, the deep aquifer sources that the Zoo wells draw upon were completely unaffected.

The proposed dewatering for construction of the RWTP at the Fleishhacker site would occur closer to the Zoo wells than occurred during the Lake Merced Transport construction project, but the anticipated effects on the Zoo wells would likely be on the same order of effect, i.e., 15 feet of drawdown, since the dewatering activities would be of shorter duration. Since the Zoo wells are screened primarily in the deep aquifer (but also include some screening in the shallow

aquifer), the dewatering drawdown in the upper 15 feet of the shallow aquifer would not be expected to impair the water quality of the Zoo wells. However, water quality monitoring should be conducted at the Zoo wells, prior to and throughout construction of the RWTP (see Chapter VII, Mitigation Measures B-3 and B-4). Discrete observation wells screened within the shallow and deep aquifer should be installed west of the construction site and between the site and the Zoo wells for the purpose of tracking chloride concentration as an indicator of saltwater intrusion. Should saltwater appear in the observation wells, the City should provide surface water supply to the Zoo and discontinue operation of the Zoo wells during the dewatering period, since operation of the Zoo wells would tend to contribute to eastward migration of the saltwater interface.

Throughout the dewatering process for the Lake Merced Project, the Zoo reported no decline in pump performance. Dewatering drawdown for that project was well above the pump settings in the Zoo wells. As described above, drawdown from dewatering at the RWTP site would not be expected to exceed 15 feet beyond the normal operating drawdown, which is well within the total drawdown of 30 to 35 feet reported for the Zoo wells under normal operation.[28] Therefore, it is expected that although temporary changes in shallow groundwater levels would occur during construction dewatering, performance of the existing Zoo wells would not be impaired by dewatering pumpage for the RWTP during construction.

The above-discussion on effects of construction dewatering is based on the existing Zoo wells. Under the Zoo Infrastructure Master Plan, new Zoo wells and pumps are planned for installation in 1996 to replace the existing system. Completion of the new wells is planned to occur prior to construction of the RWTP. Assuming the new wells will be operational and the old wells will be decommissioned prior to RWTP construction, the above impact discussion would apply to the new Zoo wells rather than to the existing wells. Unlike the existing Zoo wells, the new wells will be screened only in the deep aquifer and therefore will not be subject to fluctuations in the shallow aquifer where dewatering would occur. In addition, the new wells will have new pumps and new casings and will be able to withstand greater changes in pressure, if any, than the existing wells. Therefore, although temporary changes in groundwater levels would occur during construction dewatering, no effects on pump performance of the new Zoo wells would be expected.

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[28] Environmental Science Associates, *Report of Pump Discharge Test and Water Sampling,* San Francisco Zoo, Well #4, December 1991.

If the new Zoo wells are not completed prior to construction of the RWTP, the City would consider performing a pump efficiency test on the existing wells as a precaution prior to construction to establish a baseline of pump performance. This test could be repeated following construction if Zoo staff believe that well performance has declined during that period. The City could also consider funding increased pumping costs, if Zoo staff demonstrate that those costs have exceeded normal operating costs for the season and level of use. (See Mitigation Measures B-8.)

Reservoirs and Pipelines

During excavation at the proposed reservoirs at Lincoln High School and McLaren Park, construction dewatering may be necessary if the depth of excavation is greater than the depth to the groundwater. For both reservoirs, the proposed depth of excavation would be less than 32 feet below ground surface (see Table 8, p. 68) The Lincoln High School site appears to be the only reservoir site with data indicating that groundwater has been encountered at less than 30 feet. At McLaren Park, the reservoir would be located in a ridge area near bedrock where only minimal seepage is expected, and construction dewatering would not likely be required.

Soil borings completed in 1967 at the Lincoln High School site indicated groundwater at between 18 and 32 feet below ground surface. If groundwater dewatering is necessary during construction, a dewatering pump system would be installed that would divert the shallow groundwater from the construction area, and the groundwater pumpage would likely be discharge to the combined sewer/stormwater system, assuming that the quality of the discharge meets the requirements of Article 4.1, Industrial Waste, of the San Francisco Public Works Code. Any effect on the local groundwater flow pattern would be temporary, less than 12 months, and would affect only the shallow groundwater. The closest well to the Lincoln High School site is the irrigation well in Stern Grove, about 4 to 5 blocks south. Due to the distance from the reservoir site and the proposed depth of the excavation, it not anticipated that dewatering activities at the Lincoln High School site would affect the irrigation well at Stern Grove. As part of construction monitoring, water levels and water quality at nearby wells, such as the Stern Grove well, would be monitored prior to, during and after dewatering activities as necessary to minimize any effects on on-going groundwater users.

During construction of the transmission/distribution pipelines, groundwater might be encountered in the relatively shallow trenches which could require dewatering. As described in Chapter III (p. 109), the maximum depth of the trenches would be about 8 feet. Based on

groundwater level information for the facility sites, the depth to groundwater at the RWTP site at Fleishhacker Pool would be about 1 to 2 feet below ground surface and at the Lincoln High School site, about 18 feet below ground surface. Therefore, construction dewatering may be required along the pipeline segments close to the RWTP site, i.e., along Sloat Boulevard and possibly 45th Avenue. The dewatering system would be similar to, if not the same as the one proposed for the RWTP. Effects on nearby wells, such as the Zoo well, would be the similar to those discussed above for the RWTP, although the pipeline trench excavation would be much smaller and the construction would be shorter in duration than that for the RWTP. At pipeline segments closer to Lincoln High School, groundwater is not expected to be encountered during trench excavation.

A.3 PUBLIC HEALTH AND WATER QUALITY

Introduction

Public health and water quality effects of using recycled water would primarily be associated with long-term implementation and operation of the RWMP, and generally on a systemwide basis. There would be no public health impacts associated with exposure to recycled water during construction of any of the facilities, nor would there be any site-specific, long-term public health impacts related to exposure to recycled water at any of the proposed facility sites.

Public Health Effects of Recycled Water Use

The long-term use of recycled water throughout the City could result in public health concerns associated with water quality. However, based on numerous reuse studies, demonstrations and ongoing programs throughout California, no adverse health effects would be expected with use of recycled water that is treated to acceptable water quality standards. Regulations dictating the production, monitoring and distribution of recycled water have been established by the California Department of Health Services (DOHS) and the Regional Water Quality Control Board (RWQCB) to assure public health protection. The California wastewater reclamation criteria have been determined to provide a high degree of health protection, particularly for non-potable uses.[1]

The acceptability of recycled water for any particular use is dependent on the physical, chemical and microbiological quality of the water. Factors that affect the quality of recycled water include the quality of the water supply source, the wastewater treatment processes, treatment reliability, and distribution system design and operation. In the proposed RWMP, the original water supply source would be San Francisco Water Department (SFWD) drinking water, which is a high quality water source compared to Drinking Water Standards (see Table 26). This water serves the westside of the City, primarily a residential area, and the resultant sewage water is treated at the Oceanside Water Pollution Control Plant (WPCP) at a secondary level. The secondary effluent would be the influent to the recycled water treatment plant. There would be limited industrial wastewater sources in this part of the City that could adversely affect water quality of the secondary effluent or the recycled water. The recycled treatment process and treatment reliability requirements would be designed to meet Title 22 standards for unrestricted uses of less than 2.2 total coliform bacteria per 100 milliliters, providing the highest level of treatment under

[1] Crook, James, *Quality Criteria for Reclaimed Water*; *Water Science Technology*, Vol. 24, No. 9, 1991.

TABLE 26: PROJECTED RECYCLED WATER QUALITY (all units mg/L unless otherwise noted)

Parameter	Projected Recycled Water /a/	Title 22 Requirements /b/	SFWD Drinking Water /c/	Drinking Water Standards /e/
Total Dissolved Solids	394		61	500 (S)
Specific Conductance, umho/cm	690		101	900 (S)
pH, units	7.8*		8.6	6.5-8.5 (S)
Dissolved Oxygen	8.9		no data	no standard
Total Coliform, MPN/100 ml	<2.2*	<= 2.2	0.7	5% of samples positive (P)
Turbidity, NTU	<2*	<2	0.2	5 (S)
Calcium	15.2		24	no standard
Magnesium	11.6		10	no standard
Potassium	14.0		0.5	no standard
Sodium	110.2		9.1	no standard
Chloride	146		12.9	250 (S)
Sulfate	39		5.6	250 (S)
Alkalinity as $CaCO_3$	195		35	no standard
Hardness as $CaCO_3$	110		33	no standard
Boron	0.49		no data	no standard
Silica	13		4.8	no standard
Ammonia-Nitrogen	13		no data	no standard
Nitrate	62		0.46	45 (P)
Total Phosphorus	1.9		no data	no standard
Aluminum	<0.200		0.086	1 (P)
Antimony	<0.060		<0.001	0.006 (P)
Arsenic	<0.0050		0.001	0.05 (P)
Barium	<0.010		0.010	1 (P)
Beryllium	<0.0020		<0.001	0.004
Cadmium	<0.0020		<0.001	0.005 (P)
Chromium, Total	<0.010		<0.001	0.05 (P)
Cobalt	<0.020		no data	no standard
Copper	0.0104		<0.001	1.0 (S)
Iron	0.127		0.112	0.3 (S)
Lead	<0.0030		<0.001	0.015 (P)
Manganese	0.027		0.009	0.05 (S)
Mercury	<0.00020		<0.001	0.002 (P)
Molybdenum	<0.020		no data	no standard
Nickel	<0.020		0.002	0.1 (P)
Selenium	<0.0050		<0.002	0.05 (P)
Silver	<0.010		<0.001	0.1 (S)

TABLE 26: PROJECTED RECYCLED WATER QUALITY (all units mg/L unless otherwise noted) (Continued)

Parameter	Projected Recycled Water /a/	Title 22 Requirements /b/	SFWD Drinking Water /c/	Drinking Water Standards /e/
Thallium	<0.0050		<0.001	0.002 (P)
Vanadium	<0.010		no data	no standard
Zinc	0.037		<0.005	5.0 (S)

/a/ Projected recycled water quality based on pilot study work performed at the Oceanside Water Pollution Control Plant and represents the average of data collected between February and August 1995, or dry weather flow conditions. Coliform, turbidity and pH, as indicated by *, are projected values based on pilot study work on the proposed treatment processes at the RWTP. Source: City and County of San Francisco, Department of Public Works, *Draft Recycled Water Master Plan,* July 1996.

/b/ Wastewater Reclamation Criteria, 1978 from Title 22, Division 4 of the California Code of Regulations.

/c/ SFWD drinking water data are represented by San Francisco Water Department 1994 Annual Water Quality Report, average values. Not all parameters shown. About 85% from Hetch Hetchy, 15% from local watersheds.

/d/ Drinking Water Standards include primary standards, noted with (P), are also known as maximum contaminant levels and are legally enforceable under the Safe Drinking Water Act. Lead standard shown is the federal action level, which is non-enforceable health-based guidance number. Secondary standards, noted with (S), are aesthetic standards and are not enforceable. Source: California Department of Health Services, Office Drinking Water, November 1994.

MPN = Most Probable Number; NTU = Nephelometric Turbidity Unit; umho/cm = micromho per centimeter; $CaCO_3$ = Calcium carbonate.

SOURCE: Orion Environmental Associates, 1995

Title 22 for water reuse (see further discussion below under *Treatment Plant Effectiveness*). The proposed distribution and storage system would be designed to be entirely enclosed to ensure that recycled water quality would not be degraded prior to use. All of these factors would combine to provide assurance that the proposed RWMP would provide an acceptable level of public health protection.

Treatment Plant Effectiveness

The proposed recycled water treatment system for San Francisco would be designed to produce the highest level of recycled water quality as defined in the Title 22 regulations, commensurate with water quality acceptable for activities with high public contact, such as water contact sports (e.g., swimming) or for spray irrigation of food crops, even though these uses are not proposed as part of the RWMP. Proposed recycled water uses in the RWMP, such as landscape irrigation at parks and playground, fire fighting, and toilet flushing, are also considered high public contact activities. The current Title 22 regulations for achieving this level of quality is based on treatment process requirements (i.e., disinfected, oxidized, coagulated, clarified, filtered wastewater); while the proposed Title 22 regulations for achieving this same level of quality are based on performance standards and refer to this level as "disinfected tertiary" reclaimed water (i.e., oxidized, coagulated, filtered, and disinfected). The reclamation criteria require a turbidity level of less than or equal to 2 turbidity units in the recycled water, which would be achieved in the proposed recycled treatment plant by an in-line filtration process. The Title 22 criteria of 2.2 total coliform/100 ml in the recycled water would be achieved by disinfection with ultra-violet (UV) light. These proposed treatment processes were shown to be effective in a series of pilot studies conducted by the Department of Public Works and are discussed below.

Filtration Process. The in-line filtration process would provide further reduction in suspended and colloidal solids (and any associated contaminants adhered to or adsorbed onto these particles) over the secondary treatment process at the Oceanside WPCP. This process would include: (1) addition of aluminum sulfate (alum) and polymer to the Oceanside WPCP secondary effluent to promote floc formation;[2] and (2) passing the effluent through a sand filter, which is a bed of silica-sand. The filtration process would reduce the turbidity of the effluent from about 7 NTU,[3] which is the average turbidity of the Oceanside WPCP secondary effluent, to less than or equal to 2 NTU as a daily average and no more than 10 units as a maximum, as required by Title 22.

Disinfection Process. The UV disinfection process would provide inactivation of bacteria, viruses and other microorganisms, as measured by the indicator, coliform bacteria. The secondary effluent at Oceanside WPCP is not tested for coliform bacteria, since discharge is currently to the ocean and coliform testing is not required by the RWQCB. However, the coliform levels in the secondary effluent are known to require disinfection to meet the Title 22

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2 Floc formation or flocculation is defined as the process by which chemicals are added to wastewater which enhance the formation of solid particles from suspended matter in the effluent.

3 NTU stands for Nephelometric Turbidity Units and is the standard measure of turbidity

requirement for recycled wastewater. In compliance with Title 22, the recycled water would undergo disinfection such that it would have an average (median) coliform level of 2.2 coliform bacteria per 100 milliliters and would not exceed 23 coliform bacteria per 100 milliliters more than once in 30 days. The coliform standard has been developed as an indicator of the effectiveness of wastewater treatment processes, primarily for removal of bacteria and viruses and other disease-causing microorganisms. Although there has been some question as to the accuracy of the coliform bacteria as an indicator of pathogenic microorganisms, the use of recycled water that reliably meets accepted coliform standards has not resulted in obvious community health problems.[4]

Pilot Study. To test and demonstrate the effectiveness of the proposed recycled water treatment processes, the Department of Public Works conducted a pilot study from June to October 1994 using the proposed in-line filtration and UV disinfection on effluent from the Oceanside WPCP on a reduced-scale model.[5] The pilot study consisted of a series of controlled experiments to analyze the capability of the proposed filtration and disinfection units to meet Title 22 reclamation requirements and to determine the design and operational parameters of the proposed full-scale tertiary plant. In addition, the pilot study tested the ability of the plant to meet the UV Disinfection Guidelines prepared by the National Water Research Institute for the California Department of Health Services. These guidelines provide criteria for determining equivalency of UV disinfection to chlorine disinfection in wastewater reclamation plants; the criteria include, in addition to the turbidity and coliform requirements of Title 22, a virus inactivation standard based on bacteriophage[6] measurement as an indicator for pathogenic viruses.

Results of the pilot study indicated that the in-line filtration process was an effective technique for turbidity reduction and could be used to achieve consistently the Title 22 turbidity standard with appropriate dosing of alum and polymer. The California Department of Health Services has indicated that based on pilot study testing the proposed in-line filtration system would be acceptable to meet Title 22 requirements.[7] The pilot study also demonstrated that the UV disinfection was consistently able to reduce coliform levels to Title 22 standards at a range of

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4 Cooper, Robert C., *Public Health Concerns in Wastewater Reuse*; *Water Science Technology*, Vol. 24, No. 9, 1991.

5 Jolis, Domingo and Lam, Curtis, *The Dynasand/UV Disinfection Pilot Study at the Oceanside Water Pollution Control Plant. Final Report.* City and County of San Francisco, Department of Public Works, Environmental Engineering, May 1995.

6 Bacteriophage is a microscopic agent that destroys disease-producing bacteria in a living organism and is normally present in domestic sewage.

7 Kiado, Michael, Senior Sanitary Engineer, California Department of Health Services, 1994. Letter to Karen Kubick, Department of Public Works, City and County of San Francisco, dated January 21, 1994.

UV doses. However, the pilot study indicated that within the same range of UV doses, the UV disinfection system was not consistent in bacteriophage inactivation to levels outlined in the UV Disinfection Guidelines. Therefore, DPW has proposed using the recommended UV dose specified in the UV Disinfection Guidelines rather than the levels used in the pilot study in order to assure adequate levels of disinfection.

Overall, the results of the pilot study demonstrated that the proposed in-line filtration and UV disinfection processes consistently met the Title 22 coliform and turbidity standards. Therefore, it is expected that full-scale development of a recycled water treatment plant with in-line filtration and UV disinfection would consistently meet Title 22 water reclamation criteria and would produce recycled water of acceptable quality to protect public health. Prior to final design of the recycled water system, DPW would need to obtain approval from both the Department of Health Services and Regional Water Quality Control Board regarding adequacy of the specifically proposed filtration and disinfection system and design parameters in meeting public health requirements of Title 22 reclamation criteria (see Chapter VII, Mitigation Measures C-1 through C-7).

Recycled Water Quality

Table 26 (p. 274) presents a water quality comparison of SFWD drinking water and projected recycled water quality based on Oceanside WPCP secondary effluent. SFWD drinking water is shown only as a basis of comparison for existing potable water and it also represents the quality of the original source water of the recycled water. The projected quality of the recycled water, with the exception of turbidity, coliform, and pH, is anticipated to be the same as the Oceanside WPCP secondary effluent as a worst-case estimate, since the dissolved constituents in the secondary effluent and recycled water would be the same, but the proposed filtration, disinfection and pH adjustment at the RWTP would affect the turbidity, coliform and pH, respectively. Title 22 reclamation criteria and drinking water standards are also presented in the table as a basis for comparison. As shown in the table, the SFWD drinking water is of very high quality, with measured levels of contaminants well below the maximum contaminant levels. The SFWD water is in complete compliance with drinking water standards (including standards for other constituents not shown on the table). Due to the high quality of the drinking water and the limited industrial wastewater, the projected levels of contaminants in the recycled water for the constituents shown (primarily inorganics and metals, data for organic compounds not available)

are, with the exception of coliform, turbidity, and nitrate, less than the Drinking Water Standards.[8]

This is an extreme comparison, since the recycled water (or secondary effluent) is not required to or intended to comply with Drinking Water Standards. However, the comparison does indicate that for most constituents , the level of public health protection associated with exposure to recycled water would be comparable to the rigorous levels used in the development of Drinking Water Standards.

For coliform and turbidity levels, the secondary effluent would undergo filtration and disinfection at the recycled water treatment plant so that the recycled water would meet the existing and proposed Title 22 wastewater reclamation standards. As discussed previously, the coliform levels would be treated to levels not exceeding 2.2 total coliform per 100 milliliters, as required under the existing Title 22 regulations. The turbidity levels of the recycled water would be reduced to less than 2 NTU as required by the proposed revisions to Title 22 reclamation criteria.

With regards to nitrate levels in recycled water, although the projected level of 62 mg/L is higher than the Drinking Water Standard of 45 mg/L, as stated previously, the recycled water is neither required to nor intended to comply with this standard. Recycled water would clearly not be for potable uses, and there would be no public health effects associated with nitrate as long as the recycled water is not ingested. For further discussion on nitrate levels in recycled water, see Section V.A.2, Groundwater and Surface Water (p. 261).

Public Exposure to Recycled Water

Despite the extensive level of treatment of recycled water prior to delivery to the reuse sites, there could be a public health concern due to the origin of recycled water as wastewater. There would be no public health risk associated with any external body contact (dermal contact) with recycled water, since the recycled water would be considered safe for swimming, but the only

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[8] In order to make a direct comparison of recycled water quality with Drinking Water Standards, the analytical reporting limit for each constituent in the recycled water should be less than the Drinking Water Standard. This was the case for all constituents except for antimony and thallium: antimony was measured at <0.060 mg/L in the recycled water, and the Drinking Water Standard is 0.006 mg/L; thallium was measured at <0.0050 mg/l and the Drinking Water Standard is 0.002 mg/L. Since the standards are lower than the level of accuracy reported for these two constituents, it is not possible to state whether or not the concentrations are less than the standards for these two constituents. The reporting limits for all other constituents in the recycled water were low enough to permit a direct comparison with Drinking Water Standards.

public health concern would be associated with the chance of either direct or indirect ingestion of recycled water.

Exposure Pathways. The possibilities for direct or indirect ingestion of recycled water by the public would be at the various user sites or downwind of the sites through the following methods of exposure: inhalation of aerosols from recycled water, ingestion of food or water on which aerosols from recycled water have settled, or direct contact with recycled water through cross-connections with the potable water system. Aerosols or spray from recycled water could result from sprinkler irrigation or from condensation or emissions from office cooling systems. As described in Chapter IV, Public Health and Water Quality (pp. 182 to 187), extensive studies on recycled water, including aerosols, have indicated that no adverse health effect would be expected if the recycled water is treated to acceptable standards. Public exposure to recycled water through inadvertent cross-connection of the recycled water system with the drinking water system is discussed in the section following under Cross Connection Prevention.

Public exposure to recycled water would be through the proposed uses of landscape irrigation, commercial and industrial uses, and fire fighting. Actual public exposure to recycled water would be minimal under the proposed RWMP for the following reasons: (1) for landscape irrigation, the majority of landscape irrigation would occur in the early morning, pre-dawn hours, and general public contact with the landscaped areas would not occur until after the residual spray has been exposed to sunlight and dried; (2) toilet flushing with recycled water would occur in office buildings for use primarily by adults, and there would be limited contact by small children (which is the group most susceptible to come into direct contact with water used for toilet flushing); (3) office cooling systems and industrial uses would generally be totally enclosed, with limited potential public contact except possibly through aerosols, which have been demonstrated not to result in public health effects (see Chapter IV, p. 182); (4) fire fighting uses may involve incidental public exposure during emergencies, with potential dermal contact or limited aerosol exposure; and (5) fire fighters would have only dermal or aerosol exposure to recycled water and would be specifically educated as to the proper handling precautions for using recycled water. In addition, the City would be required to implement measures to minimize public contact with recycled water under a water reclamation permit administered by the Regional Water Quality Control Board (RWQCB) as discussed below.

Water Reuse Requirements. As discussed in Appendix B, the RWQCB is responsible for permitting water reclamation projects, which could include waste discharge requirements and water reuse requirements. These requirements, in addition to and in conformance with the

Title 22 reclamation criteria, are established to provide design measures and operational procedures for protection of water quality and public health. The RWQCB, San Francisco Bay Region, has established Water Reuse Requirements for the San Francisco Bay region, under RWQCB Order 91-042, which specify general provisions, permit holder responsibilities, users responsibilities, and a self-monitoring program. It is expected that implementation of the proposed San Francisco RWMP would operate under an individual permit issued by the RWQCB, but the general conditions specified in Order 91-042 for unrestricted reuse would likely be similar to those applied to the proposed RWMP.[9] The City would be required to file a detailed Report of Waste Discharge application to the RWQCB for review and consideration of specific water reuse requirements in an individual permit for the RWMP. More recently than Order 91-042, the RWQCB has issued Water Reclamation Requirements to the cities of Sunnyvale (Order 94-069) and Palo Alto (Order 93-160),[10] and it is anticipated that the permit for the City would be similar to these permits.[11]

The following is a list of typical and anticipated requirements contained in the RWQCB's Water Reuse Requirements, as determined by those included in the Sunnyvale or Palo Alto permits. These requirements are designed to protect public health and water quality, and specific restrictions on use as determined by the RWQCB would be included as mitigation measures under the proposed RWMP (see Chapter VII, Mitigation Measure C-4). Typical restrictions on use include:

- The treatment, storage, distribution or reuse of reclaimed water shall not create a nuisance.
- No reclaimed water used for irrigation shall be applied during periods of rainfall or when soils are saturated such that runoff occurs.
- No reclaimed water used for irrigation shall be allowed to escape to areas outside the designated use areas by surface flow or by airborne spray.
- Spray, mist or runoff shall not enter a dwelling, food handling facility, or a place where the public may be present.
- Reclaimed water shall not be used as a domestic or animal water supply.
- There shall be no cross-connections between the potable water supply and pipes containing reclaimed water.

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9 Allen, Blair, Associate Water Resources Control Engineer, Regional Water Quality Control Board, telephone communication with Joyce Hsiao, Orion Environmental Associates, dated April 10, 1995.

10 Regional Water Quality Control Board San Francisco Bay region, Order No. 94-069 Water Reclamation Requirements for City of Sunnyvale, June 1994. Regional Water Quality Control Board, *San Francisco Bay Region*, Order No. 93-160 Water Reclamation Requirements for City of Palo Alto, December 1993.

11 Allen, Blair, Associate Water Resources Control Engineer, Regional Water Quality Control Board, telephone communication with Joyce Hsiao, Orion Environmental Associates, dated April 10, 1995.

- The permit holder shall comply with the self-monitoring program as adopted by the Board [RWQCB].
- The permit holder and users shall provide employee training to assure proper operation of reclamation facilities, worker protection, and compliance with the RWQCB order.
- The permit holder and users shall assure that all above ground equipment, including pumps, piping, storage reservoir, and valves, etc. which may at any time contain reclaimed water shall be adequately and clearly identified with warning signs.
- The permit holder and users shall make all necessary provisions to inform the public that the liquid being distributed is reclaimed water and is unfit for human consumption.

The self-monitoring program referred to in the Waste Discharge Requirements are appended to the RWQCB orders and include requirements for reporting, sampling, analysis, and use observations. The monitoring program includes sampling for flow, coliform, turbidity, chemical-biological oxygen demand, dissolved oxygen, dissolved sulfides, pH, and chlorine residual at the recycled water treatment plant plus flow rate measurements and standard observations at user sites and impoundment facilities. Similar monitoring requirements would be expected for the City's proposed RWMP, and would provide a continuous, ongoing system for tracking treatment plant effectiveness and assuring protection of public health and water quality.

Engineering Report and Operational Requirements. Title 22 wastewater reclamation criteria require that any agency that proposes to produce or supply reclaimed water for direct reuse prepare an engineering report that includes the following items: (1) a clear demonstration of the means to meet the Title 22 regulations; (2) plant reliability features; (3) supplemental water supply; (4) monitoring program; and (5) a contingency plan to ensure that no untreated or partially treated wastewater will enter the distribution system. The purpose of the engineering report is to provide further assurance of compliance with water quality standards and protection of public health.

Operational requirements for the recycled water treatment plant and recycled water use are also specified in existing regulations (Chapter 9 of the Water Code). These include requirements for operations personnel qualifications, number of personnel required, and a preventive maintenance program for equipment. All operating records must be maintained at the water reclamation plant or at a central depository within the operating agency and should include the following: analysis specific to reclamation criteria; records of operational problems, plant and equipment breakdown, and diversions to emergency storage or disposal; and records of corrective or preventive actions. A monthly report summarizing the operation of the plant must be submitted

to the RWQCB and the Department of Health Services. Any untreated or partially untreated discharges to the distribution system must be immediately reported by telephone to the RWQCB, Department of Health Services and County Health Department.

Cross-Connection Prevention. Implementation of the RWMP would include construction of about 28 miles of new pipelines throughout the City as well as dual plumbing for recycled water in landscape areas and buildings meeting the specifications of the Reclaimed Water Ordinance and connection to portions of the existing AWSS. The construction of a new water distribution system of this extent creates the potential for cross-connections to be made with the existing potable water supply system and associated public health effects (i.e., direct ingestion of recycled water). Regulations contained in Title 17 of the *California Code of Regulations* specify requirements to prevent contamination of the potable water supply through cross-connection with any non-potable water system. Title 17 also requires that all reclaimed water pipes installed above or below ground after 1993 be colored purple or distinctively wrapped with purple tape so that they can be readily distinguished from potable water pipes.

Currently, there have been reported incidents of back-flow connections between the AWSS system and the SFWD potable water system during emergency fire fighting situations. These occurrences have been due to the simultaneous connection of both an AWSS hydrant and a potable water hydrant to either a pumper truck or a dry stand pipe in a building that is connected to a sprinkler system. Due to the higher water pressure in the AWSS system compared to the potable water system, there can be flow of water from the non-potable AWSS system to the potable system through this type of indirect connection. Such direct cross-connections are prohibited by Title 17, *California Code of Regulations*. The California Department of Health Services (DOHS) has notified the SFWD and issued a compliance order to correct this situation in order to maintain public health protection of the potable water supply.[12] Under the compliance order, the City is required to develop a mechanical device to prevent unprotected cross-connections between AWSS and the City's domestic water system, and to implement a cross-connection control plan. The cross-connection control plan requires the following:

- A water inspector from the SFWD Water Quality Division be dispatched to every two-alarm or higher fire with the City in areas served by the AWSS. The inspector shall be

[12] State of California, Department of Health Services, 1995. Compliance Order No. 02-04-95CO-006, Catherine S. Ma, Chief North Coast Region, Drinking Water Field Operations Branch, September 29, 1995; and City and County of San Francisco, 1995. Water Reclamation Project Meeting Minutes for September 18, 1995 with representatives from California Department of Health Services, Regional Water Quality Control Board, Montgomery-Watson, and San Francisco Department of Public Works. Minutes prepared by Robin Hirano and Karen Kubick, San Francisco Department of Public Works.

authorized to review all fire-fighting operations for the prevention and abatement of unprotected cross-connections.

- The City shall report all unprotected cross-connections discovered during fire-fighting operations to the Department of Health Services within 24 hours.
- In the event of an unprotected cross-connection, the City shall immediately initiate flushing and special bacteriological water quality monitoring of the affected portions of the City's domestic water system. The City shall consult with the Department regarding public notification and/or issuance of a local boil water order in response to such cross-connection events.
- The City shall file a monthly summary report of its response to fire-fighting operations to the Department of Health Services.

In response to the compliance order, the City has prepared a *Cross Connection Control Plan for Fire Fighting Operations*.[13] The plan includes measures to eliminate unprotected cross-connections during fire-fighting operations by utilizing mechanical cross-connection control devices on fire trucks and/or on domestic water system hydrants. The plan identified two possible auxiliary check valves that could be connected to the AWSS hydrants, the hose connection or the fire trucks. The SFFD is currently evaluating these devices in the field for compatibility with their operational requirements, and testing is scheduled for completion by December 1996. In addition, the SFFD has adopted General Order 88 A-68 which contains operating guidelines for the use of the AWSS system, which include precautions to prevent cross connections with the potable water system. The plan recommends the use of the check valve system in conjunction with stricter standard operating procedures, increased inspection and testing frequency, and additional training for both SFFD and SFWD personnel as the best protection for cross connection control while minimizing the impact on fire fighting procedures.

During the permitting process for the RWMP and its implementation, the DOHS would review the RWMP and the engineering report for Title 22 compliance. The DOHS would require that all cross-connection and backflow possibilities be corrected and eliminated prior to consideration of RWMP facilities. Therefore, it is expected that all cross-connection possibilities between the AWSS and the potable water system would be eliminated to the satisfaction of DOHS prior to approval and implementation of the RWMP, and cross-connection between the recycled water system and the potable water system could not occur.

[13] Olivia Chen Consultants, Inc., *Cross Connection Control Plan for Fire Fighting Operations*, prepared for San Francisco Water Department, Water Quality Division, December 1995.

In addition, the RWQCB's Water Reuse Requirements, as discussed above, would prohibit any "cross-connection between potable water supply and piping containing reclaimed water." Similar to other permits issued to Bay area cities, the RWMP requirements would also likely specify "supplementing reclaimed water with water used for domestic supply shall not be allowed except through an air-gap separation" and "an air-gap or reduced pressure principle backflow device shall be provided at all domestic water service connections to reclaimed water use areas." Compliance with these regulations during design and construction of the recycled water distribution system would prevent any potential for cross-connection between the potable water system and the proposed recycled water system. Therefore, there would be no possibility of direct ingestion of recycled water through pipeline cross-connections.

Treatment Plant System Reliability

System reliability refers to the ability of the wastewater treatment system to consistently produce the required water quality and to consistently provide adequate supply for the designated uses. Factors affecting system reliability include: variations in the treatment or distribution system operations due to conditions such as power outages; equipment failure or operational error; or any conditions affecting the quality of the secondary effluent used as inflow to the recycled treatment plant. A pipeline leak or rupture or valve malfunction would cause a failure in the distribution system and could also affect end users. The proposed recycled water system would include design features to address potential system reliability problems resulting from these factors and to offset normal variations in typical system operations.

As discussed above, plant reliability features are required under Title 22 to be addressed in the engineering report submitted to the Department of Health Services. Title 22 also requires the development of contingency plans to ensure the service reliability of the treatment system. During the permitting process for the RWMP, the City would be required to prepare a contingency plan detailing actions in the event of water recycling system failure. In addition to required water reclamation reliability features, the proposed recycled water system would need to meet the AWSS reliability requirements for emergency fire fighting flows.

Back-up Storage. The major system reliability feature would be the provision of adequate storage in the proposed reservoirs, which would allow monitoring and assessment of water quality before reuse as well as a backup supply for the users. The proposed storage reservoirs are designed to provide adequate storage for 1-1/2 days during average usage or for one day during peak usage. The reservoirs could continue to provide recycled water to the users in the

event of a one-day upset condition at the tertiary plant. As an additional precaution to assure adequate supply to the users, there would be a potable water connection (either SFWD water or groundwater) at each of the reservoirs in the altitude valve vault as a back-up or emergency supply. The potable water supply connection would be designed with no direct connection (i.e., an air gap) to the recycled water system and backflow preventor so that there would be no possibility of cross connection between the recycled water system and the potable water system. The air gap feature allows potable water to enter a non-potable system but prevents any flow of the non-potable water back into the potable water system For system upsets lasting several days (which could occur if there is extreme wet weather, prolonged power failure, or a major biological upset at the Oceanside WPCP), the potable water back-up at the reservoirs would initially be used, and then recycled water customers would be asked to conserve water by curtailing non-crucial uses. It is recommended that cooling systems maintain a back-up connection to the potable water system to provide the necessary reliability (see Chapter VII, Mitigation Measure C-11).

Influent Monitoring. At the Oceanside WPCP, secondary effluent would be monitored daily to assure adequate quality of inflow to the tertiary treatment plant. Any upsets at the Oceanside WPCP resulting in excessively high turbidity (generally greater than 10 turbidity units), for example, would require the City to determine if the effluent should bypass the tertiary plant and be discharged to the ocean outfall or if it should be conveyed to the tertiary plant for further treatment. Based on Oceanside WPCP operating data, a 96 percent probability exists that the secondary treatment plant will achieve turbidity levels of 10 NTU or less. In the event that the secondary effluent does not meet the turbidity requirement, it may be necessary to bypass the tertiary plant. If a bypass were to occur, the recycled water system could continue to operate for one day from backup storage provided in the storage reservoirs. Similarly, in the event of an upset at the tertiary plant, the recycled water system could provide water to the users from the backup supply in the clearwell (storage for recycled water at the recycled water treatment plant).

Recycled Water Quality Monitoring. Water quality of the recycled water system would be assured through continuous and daily monitoring of the system at the tertiary plant, as would be required by the RWQCB's self monitoring program (as discussed above, p. 286). Turbidity could be monitored continuously on-line, which could be connected to an alarm system that would activate above a certain turbidity set point. Coliform would be monitored daily to assure effectiveness of the disinfection system and compliance with Title 22 wastewater reclamation standards. Any effluent of the recycled water treatment plant that did not meet the reclamation requirements would be sent back to the Oceanside WPCP rather than to the recycled water clear

well and distribution system. The distribution system would be totally enclosed to assure that water quality is maintained after it leaves the treatment plant. The altitude valve vault at the reservoir would include a small hypochlorite storage and feed system to control algae and to assist in reservoir cleanings. The City would conduct recycled water quality sampling and observations at the tertiary treatment plant, storage reservoirs and user sites as required by the RWQCB water reclamation requirements.

Standby Power and Pumping Capacity. In the event of a power failure, the pump stations at the tertiary plant and at Lincoln High School reservoir would include standby power for pumping so that recycled water could be pumped from the recycled water storage at the plant to the reservoirs so that recycled water could be provided for emergency fire protection. The standby power is proposed to be an on-site diesel engine generator, with on-site storage of diesel in an underground storage tank. The filtration and disinfection treatment processes, however, would be inoperable during extended power outages, and if necessary the secondary effluent from the Oceanside WPCP would bypass the tertiary treatment plant and be discharged to the ocean. There would also be redundancy in pump capacity which would permit the system to continue to operate during maintenance on individual pumps.

Transmission/Distribution System Pipeline Design. The pipelines for the proposed transmission/distribution system would be constructed to AWSS standards and thus would be designed to accommodate higher pressures than typical water distribution systems. Therefore a pipeline leak or rupture would be an unlikely occurrence. However, in the event of a damaged pipe, the extent of disruption to the overall system would depend on its location. If the damage were to occur between the secondary treatment plant and the RWTP or between the RWTP and the reservoir, then back-up storage in the reservoir would be available to meet the demand during repair of the pipe. If the damage were to occur to the transmission or distribution pipes, then specific nearby customers could be temporarily denied recycled water. The proposed system of multiple branches, loops and inter-zonal connections would allow the damaged section of pipe to be isolated from the system between isolation valves, while allowing the remainder of the system to operate during pipe repair. Typically, pipeline repairs are completed within a few days.[14]

Summary of Public Health Effects of Recycled Water

In conclusion, based on results of numerous public health studies and demonstrations, on evidence from numerous, existing, successful wastewater programs in California, and on the

[14] City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan, Draft*, July 1996.

extent of existing (and proposed) regulatory requirements for water reclamation, implementation of the proposed recycled water system would not be expected to result in public health effects for the proposed non-potable uses. The proposed treatment and distribution facilities of the RWMP would provide adequate safeguards for treatment plant effectiveness and system reliability to assure compliance with state regulations for wastewater reclamation for disinfected tertiary recycled water for un-restricted uses. This would provide a high degree of health protection for the proposed non-potable uses, including landscape irrigation, fire protection, and commercial/industrial uses.

Other Recycled Water Quality Considerations

In addition to public health concerns with recycled water, other water quality considerations include the effects of recycled water on plants and soils and on commercial/industrial equipment and facilities. Landscape irrigation effects from use of recycled water on plants and soils are discussed later in this chapter under Section V.A.10, Biological Resources (pp. 363 to 373). Industrial/commercial facility concerns with recycled water quality are discussed below.

Effects of Recycled Water on Industrial/Commercial Uses

The RWMP proposes that about 2.4 million gallons daily of recycled water would be distributed for industrial and commercial uses in the City. Typical industrial uses of recycled water include cooling, processing, boiler feeding and washing. Commercial uses could include air conditioning cooling systems and toilet flushing. Water quality requirements of recycled water would depend on the specific application of recycled water.

The predominant industrial application of recycled water is for cooling , which would likely be the case in San Francisco. Quality requirements for industrial cooling would depend on the specific type of cooling systems, such as "once-through" systems or recirculating systems. The major problems associated with using recycled water for cooling are scale formation, corrosion, and biological fouling. Scale formation is caused by the phosphorus, calcium, magnesium, iron and silica in recycled water. The presence of ammonia in recycled water could cause corrosion in copper-based alloys, stimulate microbial growth and interfere with disinfection. Biological fouling is the excess growth of bacteria and other microorganisms which can interfere with equipment and process. It is stimulated by the presence of residual organics, ammonia, and phosphorus in the recycled water. Additional treatment by the user industry may be required for

recirculating cooling systems and could include lime clarification or alum precipitation for nutrient removal. Other chemicals may be added for pH control, if necessary.

For "once-through" systems, the projected recycled water quality is anticipated to be adequate since the cooling water would circulate through the system one time only; the proposed in-line filtration process for the recycled water would not likely result in scaling and corrosion problems in a once-through system, and the proposed UV disinfection would be expected to inhibit biological fouling and algae growth in industrial systems. For recirculating cooling systems, the quality requirements for recycled water would depend on the number of recirculation cycles and degree of concentration of recycled water. Recommended criteria for cooling makeup water in recirculating systems indicate that the proposed quality of recycled water would in most part (except for only ammonia, phosphorus, pH and possibly aluminum) be within the suggested limits, as shown in Table 27, although site-specific water quality needs may require additional on-site treatment or chemical additions Possible industrial treatment requirements could include de-ionization, addition of chemicals to reduce scaling, adjustment in pH, or addition of chlorine for additional disinfection or algal control. Therefore, implementation of the RWMP could provide recycled water of adequate quality suitable for industrial users. However, the recycled water supply would be considered an "interruptible" system, since in the event of an emergency, fire protection uses of the recycled water would take highest priority. A back-up connection to an alternative water supply system, would be recommended for industrial water users that require a constant water source to provide adequate system reliability in the event of prolonged failure of the recycled water system.

The proposed uses in the RWMP include use of recycled water in commercial offices and buildings, such as for toilet flushing and for air conditioning units. The City's Reclaimed Water Use Ordinance requires dual plumbing systems to be installed in all new or remodeled buildings and all subdivisions (with the exception of condominium conversions) with a total area of 40,000 square feet or greater within the Reclamation Ordinance Zone (see Chapter II, Figure 2, p. 8). The dual plumbing would be used for irrigation, toilet flushing and industrial processes for these buildings. Required signage and color-coding of piping and equipment in commercial offices and buildings would minimize any public health exposure to recycled water, as previously discussed. Water quality is generally not a concern with respect to toilet flushing, with the possible exception of effects on pipelines, as discussed below. Irrigation effects from use

TABLE 27: RECYCLED WATER QUALITY FOR COOLING MAKEUP WATER (mg/L, unless otherwise noted)

Parameter	Recommended Limit for Cooling Makeup Water /a/	Projected Recycled Water Quality /b/
Silica	50	13
Chloride	500	146
Total dissolved solids	500	394
Hardness	650	110
Alkalinity	350	195
Total suspended solids	100	no data
Ammonia	1.0	16
Aluminum	0.1	<0.200
Iron	0.5	0.127
Manganese	0.5	0.027
Calcium	50	15.2
Magnesium	30	11.6
Bicarbonate	24	no data
Sulfate	200	39
Phosphorus	1.0	1.9
pH, units	6.8-7.2	7.8
Total coliform, MPN/100 ml	2.2	<2.2

/a/ Recommended levels for cooling makeup water for 5 cycles of concentration from Crook, James, 1991. Quality Criteria for Reclaimed Water. Water Science Technology, Volume 24, No. 9, pp. 109-121.

/b/ Projected recycled water quality based on average of data collected between February and August 1995 at Oceanside Water Pollution Control Plant which represent dry weather flow. Coliform and pH values based on proposed treatment processes at RWTP, including disinfection and pH adjustment. Source: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan, Draft*, July 1996.

SOURCE: Orion Environmental Associates, 1995.

of recycled water are discussed under Section V.A.10 (pp. 363 to 373). Water quality considerations for air conditioning units would be similar to those discussed above for industrial cooling systems, though at a smaller scale, and would not be expected to be problematic.

Effects of Recycled Water on Pipelines

Water or moist soil can be corrosive to pipe materials due to electrochemical reactions between chemicals present in the water and the chemicals in the pipe materials. Corrosion is the formation of pits on the pipe surface or thinning of the pipe material that reduces the useful life of the pipe material and can lead to cracking and pipe failure. A study of corrosion control for the proposed recycled water system was performed by CH2MHill in June 1995 to assess the corrosion potential of soil and water and to identify appropriate corrosion control measures for design of the RWMP.[15] The study determined that the projected recycled water quality, without pH adjustment, is considered corrosive to uncoated ferrous metals, copper and aluminum as a result of the high concentrations of chloride and total dissolved solids. The recycled water quality is also considered corrosive to concrete and cement mortar because of its low concentration of calcium, which can cause leaching of the cement paste from concrete surfaces. The corrosive nature of the water quality is referred to as "aggressive." The addition of alum in the proposed recycled water treatment process would tend to lower the pH of the recycled water and thus make the recycled water more "aggressive."

The projected quality of the recycled water, without pH adjustment, could cause corrosion in the proposed ductile iron pipe with cement mortar lining of the system's overall transmission/distribution pipelines. The study determined that without pH adjustment, the service life of the pipes would be reduced from 75 years to about 35 years. The corrosion potential of the recycled water could also affect portions of the existing AWSS pipelines, which are made of ductile iron pipes. In addition, the Recreation and Park Department plans to use ductile iron pipe for the planned new irrigation pipeline system in Golden Gate Park in order to meet their operating conditions which requires high pressure and quick shut-down throughout the day. Ductile iron pipe could be subject to corrosion if used to convey "aggressive" water. In order to reduce the corrosion potential of the recycled water, the RWMP would include a stabilization process at the treatment plant to raise the pH of the recycled water, thereby reducing the corrosion potential of the water. The pH adjustment would be achieved through addition of caustic soda during tertiary treatment, upstream of the clearwell and prior to the recycled water entering the distribution system. The amount of caustic soda added to the recycled water would be determined such that the corrosion potential of the recycled water would be similar to the City's groundwater supply, since corrosion problems associated with the groundwater system piping have not been reported. The pH of the secondary effluent would be increased from about

[15] Price, Tom, CH2MHill, 1995. *Recycled Water System Corrosion Control*, Technical Memorandum prepared for Karen Kubick, San Francisco Department of Public Works, June 26, 1995.

7.1 to about 7.8 in the pH-adjusted recycled water. The actual dosing of caustic soda would vary, depending on the quality of the secondary effluent, and the pH adjustment system would be designed with an allowance to vary the dosing rate as necessary. The pH of the recycled water would be monitored continuously at the RWTP and corrosion potential would be monitored periodically to extend the service life of affected pipelines and to minimize pipeline maintenance problems.

A.4 PUBLIC SERVICES AND UTILITIES

Introduction

The following impact analysis is organized by topic. All impacts on public services are evaluated on a program-level basis only because they relate to overall system operation or construction at all facility sites. Refer to Section V.A.12, Energy and Natural Resources, for discussion of energy utility needs associated with the RWMP.

Water Supply System

Chapter VI, Water Supply Effects and Growth Inducement Potential of the RWMP and GWMP (pp. 435 to 471 discusses potential overall effects of the project on water supply; this section addresses potential effects of the project on the water supply infrastructure system.

The recycled water distribution system would be isolated from the existing potable water supply system so that there could be no cross-connection and mixing of recycled and potable water, as required under Title 17 of the *California Code of Regulations*. In addition, this regulation also requires that all reclaimed water pipes installed above or below ground after 1993 be colored purple or distinctively wrapped with purple tape so they can be readily distinguished from potable water pipes. Cross connection issues are discussed further in Section V.A.3, Public Health and Water Quality (pp. 273 to 292).

During construction, installation of RWMP pipelines could result in short-term, localized disruption of other existing utility lines, including water system facilities, in the event of a pipeline routing conflict or an accidental breakage. However, in most cases, pipelines could be repaired by emergency crews and disruption of services would be less than one day (see Chapter VII, Mitigation Measure D-1). In areas where the proposed project would replace potable water with non-potable water (irrigation sites, etc.), the substitution from potable to non-potable water would not cause disruption of water service, since the pipelines for the two distribution systems would be entirely separate and would remain so. The existing potable water infrastructure would then be available as a back-up system in the event of a prolonged failure (more than 1-1/2 days during average usage) of the recycled water system. The recycled water system has incorporated back-up storage of recycled water for 1-1/2 days within the system (see further discussion of back-up storage in Section V.A.3, Public Health and Water Quality, p. 273).

Implementation of the RWMP would provide a non-potable water supply and distribution system, which would replace the potable supply and distribution system for the designated recycled water users. Recycled water projects would therefore reduce the demands and associated service requirements upon the potable water system infrastructure. Recycled water would be a local water supply, and would increase the diversity and reliability of San Francisco's potable water system.

Fire Protection - Auxiliary Water Supply System (AWSS)

The RWMP proposes to use parts of the AWSS to distribute recycled water to users. Under the RWMP, some of the existing AWSS pipelines would be used, new pipelines would be installed to extend the AWSS service area, and some portions of the existing AWSS would not be disturbed. The San Francisco Department of Public Works (DPW) conducted an analysis of the potential impacts on the reliability of the AWSS system of using the AWSS for recycled water distribution.[1] The reliability of the AWSS with respect to fire protection is dependent upon the following system features:

- Adequate pressure and flow available at each hydrant;
- San Francisco Fire Department (SFFD) control over the system; and
- Prevention of water loss from the system.

In order to ensure that the reliability of the AWSS is not compromised by use of the system for recycled water transport, the recycled water distribution system would incorporate the following design guidelines:

- Create three separate pressure zones;
- Establish no direct connection to the AWSS in the Downtown area;
- Minimize the number of direct connections to the AWSS;
- Install isolation valves to maximize separation of the AWSS from the recycled water system; and
- Add two reservoirs to provide operational storage for emergencies.

The recycled water distribution system would be configured to minimize connections to the AWSS and to reduce potential effects on the AWSS.[2] Recycled water would be distributed to users via connection valve vaults. In most circumstances, each valve vault would serve several local individual users. The purposes of these valve vaults would be to[3]:

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1 City and County of San Francisco, *Water Recycling Master Plan Operation Control Plan With AWSS, Draft (Revised)*, April 1994.
2 ibid, p. 5.
3 ibid, p9.

- Provide a single control location for SFFD;
- Isolate the recycled water users from the AWSS and the recycled water transmission line; and
- Provide pressure reduction and metering.

Only valve vaults in the Southeast Zone would be connected to the existing AWSS. In the Richmond, Sunset and Southwest zones, the valve vaults would be connected to the new recycled water distribution system.

The Fire Department expressed concern about use of the AWSS in the densely developed Downtown area, where the potential emergency water demand during a fire is high and where the AWSS is older. The estimated demand for recycled water in the Downtown area is relatively small compared to other areas of the City. As a result, the RWMP does not propose to distribute recycled water in the Downtown area, through the AWSS or otherwise.

A key element of fire fighting reliability is SFFD's ability to shut off recycled water users in the event of a fire. System reliability could be affected by the addition of new connections to the system. The more connections to the system, the greater the number of users tapping into the emergency supply and the greater the potential for loss of pressure and water supply during an emergency. SFFD needs to have the highest priority use of the recycled water distribution system in order to protect the system's reliability as an emergency supply of fire-fighting water. The recycled water system would be designed so that all connections to the existing AWSS would be under direct SFFD control and the number of connections to the existing system would be minimized. Table 6, Distribution System Valve Vault Control Strategies (p.59), identifies several measures that would be incorporated into the recycled water system design to maintain SFFD control.

The City also investigated the amount of emergency water storage required for various fire-fighting scenarios.[4] This study showed that for normal fire-fighting scenarios, the proposed 15 million gallon (mg) of storage provided in the recycled water system could provide adequate emergency water supply. However, for the scenario in which a fire follows an earthquake, the study recommended that each of the three zones have a storage capacity of 20 million gallons (i.e., 60 million gallons total) to provide a high level of fire protection. Due to siting, potential environmental and economic constraints, however, the reservoir locations and capacities recommended by the Fire Department could not be fully satisfied as part of the recycled water

[4] Portable Water Supply System Co., Ltd, EQE International, Inc., 1994. *Reclaimed Water/Fire Protection Dual Use System, Analysis of Hydraulic and Reliability Aspects.* Prepared for San Francisco Department of Public Works and San Francisco Fire Department, July 8, 1994.

system. A suitable dual purpose reservoir site could not be located in the Richmond Zone. Sites evaluated were generally too small to provide sufficient capacity to meet fire-fighting needs and/or did not meet recycled water distribution system needs. The Lincoln High School reservoir, designed to serve the Sunset Zone, could provide some degree of improved fire-fighting capacity for the Richmond Zone, but it could not provide for delivery of emergency water by gravity.

The total storage proposed for the two recycled water reservoirs would be 25 to 35 million gallons, with 19 to 24 million gallons provided as emergency/back-up volume and 6 million gallons provided as operational volume (see Table 5, p. 50). This total storage volume would be about 42 to 50% of the optimally recommended reservoir sizing to provide protection against a fire following an earthquake.

The service pressure in the recycled water transmission pipelines and in the new sections of the recycled water distribution system would range from about 70 to 170 pounds per square inch (psi). Pressure above 100 psi is generally higher than the required pressure for most recycled water users. Therefore, each valve vault would have a pressure regulation valve vault to reduce the pressure as needed for individual users. A flow meter would also be installed at each valve vault to monitor continuously the volume of flow supplied to the storage reservoir and the volume extracted for each user; it could be used to detect leakage of water during normal operation. Each connection valve vault would also be equipped with a pressure transmitter which would set off an alarm when the pressure both upstream in the AWSS and downstream in the recycled water piping fall below a pre-determined point. To safeguard the system in the event of an earthquake, each connection vault would be equipped with an earthquake switch to isolate the AWSS during an earthquake above a specified magnitude.

The RWMP would involve construction of additional pipeline proposed for recycled water storage and distribution system, and effectively expand the AWSS fire-fighting system into the western and southern areas of the City which are presently not served with this emergency system. Figure 7, p. 25, shows the extent of the existing AWSS pipelines, and Figure 12, p. 40, shows the extent of the proposed area of expansion for the recycled water distribution system.

With the proposed recycled water storage reservoirs at Lincoln High School and McLaren Park, the southern and western areas of the City would gain additional local emergency water supplies and would have an emergency water system that could deliver high pressure water for fire-fighting in the Sunset, Southeast and Southwest service areas by gravity. The Richmond area

would also have an additional emergency water system available, but delivery of recycled water to this area for fire-fighting would require pumping either at the reservoir or pumper trucks. The use of and additions to the AWSS proposed under the RWMP would distribute recycled water in parts of the City, and at the same time, increase the distribution area and the water supply of the AWSS without compromising the reliability of the existing AWSS.

Wastewater/Stormwater System

Temporary wastewater/stormwater system disturbance may be necessary at the Westside Pump Station and the Oceanside Water Pollution Control Plant during construction of the RWTP at the Fleishhacker site. Installation of recycled water pipelines could result in short-term, localized disruption of other existing wastewater/stormwater pipelines or facilities, in the event of a pipeline routing conflict or an accidental breakage. However, in most cases, pipelines could be repaired by emergency crews and disruption of services would be less than one day.

Dewatering would likely be necessary during construction of the RWTP (see Section V.A.2, Groundwater and Surface Water Resources, Construction Impacts, p. 268). Dewatering water may be discharged to the storm drain system, which would contribute to the volume of water which must be transported, treated, and discharged by the wastewater/stormwater system. This effect would be temporary and a minor contribution to wastewater/stormwater system volume.

Construction dewatering discharge to the storm drains, as well as any run-off from the site to the stormwater system, could also contribute sediment and other construction site contaminants to the wastewater/stormwater system. The City would require that the construction contractor comply with Article 4.1 of the San Francisco Public Works Code, Industrial Waste, which regulates discharge of pollutants to the City's wastewater/stormwater system. Compliance with Article 4.1 would prevent dewatering discharge and construction site run-off from affecting the wastewater/stormwater system. Article 4.1 requires sampling of discharge to ensure that the discharge meets water quality requirements. Based on similar dewatering conducted during the Lake Merced Transport project, it is anticipated that the dewatering water would meet Article 4.1 requirements. Depending on the quality of the dewatering discharge and pending approval of the Regional Water Quality Control Board, the groundwater could also be discharged to surface waters, such as the ocean or Lake Merced.

Currently, the secondary effluent from the Oceanside WPCP is discharged to the ocean via the Southwest Ocean Outfall. The Southwest Ocean Outfall was designed to discharge 450 million

gallons daily (mgd) of pumped effluent. Currently, the operation of the outfall has been modified to accommodate flows less than the design flows, ranging from 18 mgd daily average during dry weather and over 65 mgd during wet weather.[5]

Under the proposed RWMP, a portion of Oceanside WPCP effluent would be diverted to the Fleishhacker RWTP for treatment and distribution to recycled water users. This water recycling process would reduce the volume of the discharge through the Southwest Ocean Outfall and could affect the quality of the remaining effluent discharged through the outfall.

Reduction in the volume of discharge could affect the operation of the outfall. Currently, there has been evidence of sedimentation and saltwater intrusion in the outfall, which may be attributed to low flow, but the discharge through the outfall is still operating as designed. Potential problems associated with reduced flow through the outfall include sedimentation in the diffuser and saltwater intrusion into the outfall that could eventually affect the hydraulic functioning of the outfall. DPW is now in the process of evaluating the potential problems associated with low flow in the outfall, through flow monitoring and field investigation, and results of the study are expected in the fall of 1996.[6]

During dry weather, the demand for recycled water would be the highest (due to irrigation requirements), and diversion of effluent from the Oceanside WPCP to the RWTP could be as much as 100 percent during peak demand, essentially eliminating all flow from the outfall during this period. During wet weather, however, the recycled water demand would be lower, and the percentage of Oceanside WPCP effluent diverted to the RWTP would be much lower so that discharge to the outfall would be expected to resume. If the results of the on-going outfall study indicate that zero or low flow to the outfall would result in operational problems, then implementation of the RWMP would aggravate these problems. DPW would address the potential impacts of zero flow to the outflow as part of their study, and if recommended, corrective actions to either the design or operation/maintenance of the outfall would be implemented (see Chapter VII, Mitigation Measure D-2).

Although the recycled water system would reduce the volume of discharge to the ocean outfall, the quality of the remaining effluent, if any, discharged through the outfall would not be expected to affect compliance with waste stream and receiving water parameter permit

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5 Chiu, Carolyn, Civil Engineer, Environmental Engineering Group, Oceanside Water Pollution Control Plant, 1995.

6 Telephone communication with Michele Bellows, Orion Environmental Associates, April 26, 1995.
Lundgren, Leslie, Project Engineer for Southwest Ocean Outfall Capital Improvements, San Francisco Department of Public Works, telephone communication with Joyce Hsiao, Orion Environmental Associates, December 7, 1995.

requirements.[7] The effluent limitations are based on concentration limits for a range of parameters, primarily of dissolved constituents. Diversion of any percentage of effluent flow to the RWTP would not affect the concentration of any of the dissolved constituents, but would merely divide the flow stream to either the RWTP or the outfall, with both flow streams of similar quality. Therefore, dissolved constituents would be carried with the secondary effluent to the RWTP, and eventually to the end users (see Projected Water Quality of Recycled Water, Table 26, p. 274). The reduced flow to the outfall would be expected to have the same concentration of the dissolved constituents as the current effluent.

However, under the proposed RWMP, the backwash from the tertiary treatment process at the Fleishhacker RWTP would be pumped back to the beginning of the Oceanside WPCP treatment stream. This process could have an effect on the level of suspended solids in the effluent. The coagulation and filtration process at the RWTP would precipitate and filter solids, which would then settle out in the primary treatment process at the Oceanside WPCP. The volume of return of the Fleishhacker RWTP backwash to the Oceanside WPCP would not be expected to increase the concentration of the ocean outfall discharge above the discharge permit limit of 30 milligrams per liter of total suspended solids, monthly average.

[7] U.S. Environmental Protection Agency Region IX and the San Francisco Bay Regional Water Quality Control Board, 1990. NPDES Permit No. CA0037681, Order No. 90-093 Waste Discharge Requirements for the Oceanside Water Treatment Facility and Southwest Ocean Outfall.

A.5 GEOLOGY, SOILS, AND SEISMICITY

Introduction

The following impact analysis is organized by topic. All geologic, soil and seismic potential impacts are first evaluated on a program-level basis where they relate to construction and/or operation of all RWMP facilities. Where site-specific information is available, it is presented. However, the site-specific information presented is based on preliminary geotechnical reviews completed by Geo/Resources Consultants in 1994 and 1995 for the facility sites that were under consideration at that time. Specific reservoir designs were not available at the time the geotechnical reviews were completed, and the surface of the bedrock has not been characterized at each site. While the impact analysis below identifies the general geotechnical impacts that could occur at the individual facility sites, site-specific drilling and more detailed geotechnical studies would need to be completed at each site prior to construction of all proposed facilities.

Construction-Related Erosion Hazards at All Facilities

Large quantities of soil are proposed to be excavated at the Recycled Water Treatment Plant (RWTP) and reservoir sites, where extensive underground facilities are proposed and excavation to depths of up to 30 feet would be required. In addition, excavation for installation of pipelines, while fairly shallow and narrow, would be required along approximately 28 miles of roadways. Over 300,000 cubic yards (cy) of soil (about 240,000 and 47,000 cy for the reservoirs and the RWTP, respectively, with the remainder attributed to the pipelines) would be excavated during project construction, and the excavated soils would be stockpiled and either used on-site for backfill or hauled off-site for disposal. During construction, unless adequate controls are implemented, the exposed soil and stockpiles could be subject to wind and water erosion, potentially resulting in increased dust and particulate matter as well as increased sediment loads in surface runoff that could be carried to surface waters or to the combined stormwater/sewage system. Sandy soils would be more susceptible to wind erosion than clayey soils if exposed soils are not kept wet. Mitigation measures to control the erosion of stockpiled soil and sandy slopes would be incorporated into project during construction, such as daily watering of exposed soils, covering of stockpiles, and stopping work during windy conditions (see Chapter VII, Mitigation Measure E-5).

Potential Slope Instability Hazards at Reservoir Sites

Under current conditions, the slopes at the proposed reservoir sites are considered stable. However, localized steep bedrock surfaces, orientation of planar rock surfaces, rainfall, and groundwater conditions could affect the long-term stability of the slopes. During excavation and over-excavation (excavating beyond the depth necessary for construction of subsurface structures in order to reach more stable or uniform geologic materials) for construction of the reservoirs, existing slopes at the McLaren Park sites and the Lincoln High School site could become unstable. A geotechnical engineer or an engineering geologist would need to evaluate local soil/rock stability and site-specific recommendations, such as shoring of steep slopes, would be implemented to prevent slope instability (see Chapter VII, Mitigation Measures E-1, E-7, and E-8). Once the reservoirs are in operation, any seepage from the reservoir would also have the potential to destabilize surrounding slopes. However, design measures for adequate drainage would be included in reservoir design to prevent accumulation of any seepage.

Potential Seismic Hazards at All Facilities

In the event of an earthquake, the RWTP and reservoir sites could be subjected to ground shaking, soil liquefaction, soil densification and subsidence, soil lurching, and lateral spreading. The potential for seismic ground shaking, soil liquefaction, and soil densification was addressed in the geotechnical reports prepared for the Fleishhacker Pool site and each of the reservoir sites. The impacts related to these seismic hazards are discussed below. The potential for soil lurching and lateral spreading would need to be evaluated in a design-level geotechnical report for each site.

Potential Seismic Ground Shaking

Severe ground shaking such as associated with the 1906 San Andreas earthquake or the 1989 Loma Prieta earthquake could cause major structural damage and injury at any of the proposed facilities. Because San Francisco, with the exception of the bedrock outcrop areas, is underlain by unconsolidated sediments, the City as a whole could experience strong seismic shaking during an earthquake on an active fault in the region. Structures built on areas with thick deposits of soft sediments would likely experience stronger shaking due to the amplification of the shaking intensities.

All the project structures and facilities would be subject to potential earthquake damage due to ground shaking. This could cause rupture or damage to the transmission/distribution pipelines

and underground reservoirs and the various aboveground storage tanks associated with disinfection agents.

Peak ground accelerations measured during the 1989 Loma Prieta earthquake ranged from 0.08g to 0.24g in the City and County of San Francisco. Average values for the maximum estimated bedrock acceleration for the San Francisco area ranges from 0.48g to 0.70g. The San Francisco Building Code requires that structures be designed to withstand peak ground accelerations of 0.4g. The RWTP and reservoirs would be built to this standard which would reduce the potential for damage due to seismic shaking.

Potential Seismic Liquefaction

Within the City, potentially liquefiable sediments have been identified mainly around Lake Merced with a thin apron along the western ocean front and along much of the eastern and northern Bay side of the City.[1] A major seismic event could cause liquefaction or lurching of saturated subsurface soils, resulting in total or differential settlement. The major damage associated with the Loma Prieta earthquake that heavily damaged structures in the Marina district was due to liquefaction. The proposed RWTP Fleishhacker site and some of the transmission/distribution pipelines are located in identified areas of high potential for liquefaction. Geotechnical investigations have identified that the Lincoln High School and McLaren Park reservoir sites are located in areas with low potential for liquefaction. Some of the proposed pipelines cross from areas of low liquefaction potential to areas of high potential.

A geotechnical study for the Zoo infrastructure in 1995 indicated that potentially liquefiable soils are present in the northern portion of the Fleishhacker Pool site from the ground surface to a depth from 10 to 20 feet below the existing ground surface.[2] The study indicated that the potential consequences of liquefaction include lateral spreading, lurching, bearing capacity failure, increased lateral earth pressures, settlement, and flotation of underground structures. These effects and their severity depend upon the detailed soil characteristics, the types of structures, and the severity of the earthquake, and they could occur during or following an earthquake. The study also indicated that if structures are supported at least 20 feet below the ground surface, they would not be underlain by potentially liquefiable soils, based on available boring data. The proposed depth of excavation for the Fleishhacker Pool site is 20 feet, which,

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1 URS Consultants/John A., Blume and Associates, *San Francisco Seismic Safety Investigation,* June 1974.
2 Kennedy/Jenks Consultants - AGS, Inc., 1995. *Infrastructure Geotechnical Study, Infrastructure Master Plan San Francisco Zoological Gardens.* Prepared for City and County of San Francisco, Department of Public Works, June 1, 1995.

depending on site-specific conditions, may be below the level of liquefiable soils. To prevent the potential impacts of liquefaction, special seismic resistant design may be required for some structures, and soil densification, or removal or treatment of liquefiable soils may be required (see Chapter VII, Mitigation Measures, Measure E-6).

Potential Seismic Soil Densification and Subsidence

Deposits of loose soil above the water table, if present at proposed project facilities sites, could densify and settle during severe earthquake shaking. Differential ground settlement, particularly in the proposed areas where substantial excavation would take place, such as the RWTP and reservoir sites, could cause distortion and damage to the structures and associated piping. Buried reservoir structures would be less subject to this impact. Area–wide subsidence could also occur which could damage structures and pipelines. Soils which could potentially be densified during strong ground shaking have been identified at the Fleishhacker site. The extent of potential damage to structures would depend on the thickness, depth and extent of loose or densifiable sands. As determined by site-specific geotechnical investigations, seismically-induced settlements can be prevented by over-excavation and recompaction or other design techniques such as grouting of in-situ sands (see Chapter VII, Mitigation Measure E-6).

Geotechnical and Soil Engineering Constraints at All Facilities

Potential Differential Settlement

Once constructed, the reservoirs would be expected to experience some settlement. In general, this should not be a long-term concern if the reservoirs are constructed entirely on either suitable soil or bedrock. Bedrock surfaces would need to be treated prior to construction depending on the orientation of bedding planes and the condition of the bedrock surface. In general, the bedrock beneath each reservoir site is expected to provide adequate bearing support for the reservoirs if a consistent bedrock type is encountered beneath the entire reservoir site. Much of the sand or silty sands that are present are also likely to provide adequate bearing support provided that their thickness does not vary considerably beneath the site. However, clays with a high shrink/swell potential, landslide debris, and fills of unknown origin are not recommended for foundation support. If a proposed structure is constructed on mixed rock types, then differential settlement could occur and could cause cracks and subsidence in the reservoirs, pipelines and pipe supports, and associated structures. Mixed rock types of bedrock or unsuitable soils for bearing support may be encountered at the McLaren Park site and the Lincoln High School site. Soils with unsuitable bearing capacities were identified at the

McLaren Park site and the Lincoln High School site. This soil would need to be removed and engineered fill would need to be placed to prevent differential settlement. Mitigation measures would be required at each site to prevent differential settlement; possible mitigation measures are described on Chapter VII, Mitigation Measures E-1 and E-7.

Operational phase settlement due to the reservoir and content loads should not present a long-term settlement concern if the orientation of the bedding planes and granular soils are considered in the design. Settlement due to dynamic shaking (earthquake-induced) is addressed under Potential Seismic Soil Densification and Subsidence (p. 303).

At the McLaren Park sites and the Lincoln High School sites, the bedrock surface is irregular and there may be localized steep bedrock surfaces. Construction over a steep surface would not provide adequate support for a structure such as a reservoir, and structural damage could occur. If steep bedrock slopes are present beneath a reservoir site, reservoir set backs and benching would be required to provide a suitable bearing material for the foundation as described in Chapter VII, Mitigation Measure E-7.

Differential settlement to structures adjacent to proposed facilities would not be expected, due to engineered design of bearing materials and foundations, as described above, and due to required shoring of excavations during construction, discussed below.

Potential Hazards Related to Excavation

Worker Safety. Construction of the reservoirs and clearwell would require excavation to reach the elevation of the bottom of the reservoir pad, and possibly over-excavation to obtain a uniform bearing surface. During excavation there is the potential for collapse of the excavation sidewalls which could endanger the safety of the construction workers and threaten nearby structures. The workers would be threatened by engulfment in the event that the excavation sidewalls collapsed, they could also be injured by falling debris or rock. Worker safety precautions (such as shoring and personal protective gear), as required under the California Occupational Safety and Health Administration (Cal/OSHA), would be included as part of the construction specifications to ensure that excavation conditions do not pose a safety risk to workers.

Adjacent Structures. At the Lincoln High School site, the proposed reservoir location is at or near several existing structures at the school, including a football field. Without appropriate

precautions, excavation for the reservoir could cause settlement of adjacent structures. Precautions such as underpinning or shoring, as determined by site-specific geotechnical investigations, may be necessary to prevent settlement of existing nearby structures during and after construction.

Dewatering. Dewatering would likely be necessary at the Fleishhacker Pool site to maintain stability of the excavation sidewalls and a dry working space. Dewatering to two feet below the bottom of the excavation is recommended. Groundwater generated during construction dewatering at the nearby Oceanside Water Pollution Control Plant project was discharged directly to Lake Merced, as approved by the RWQCB. Similarly and as approved by the RWQCB, groundwater generated during construction dewatering at the Lake Merced Tunnel was discharged both into Lake Merced and directly into the ocean. Refer to Section V.A.2, Groundwater and Surface Water Impacts of the RWMP, pp. 261 to 272, for additional discussion regarding potential impacts associated with construction dewatering.

Excavation of Serpentine Rock

Excavation of existing soils and rock would be required for construction at all facility sites, with extensive excavation required for the RWTP and reservoirs. There is the potential to encounter serpentine rock during excavation at all sites, which could pose a public health hazard, since serpentine rock contains naturally-occurring asbestos and asbestos is a known carcinogen. Serpentine rock is known to occur within the Franciscan Complex. During excavation activities, fragmentation of serpentine rock could result in airborne asbestos fibers that, if friable, would present an inhalation hazard to workers and the community (see also discussion under Section V.A.8, Air Quality impacts, p. 325). In addition, disposal of naturally-occurring asbestos may require special procedures if the material is considered hazardous. However, similar to numerous excavation projects that have been conducted throughout the City, contractors would be required to employ specific measures to minimize any potential impact from serpentine rock. These would include measures, such as having the resident engineer or field geologist on-site to identify serpentine materials; laboratory testing of serpentine material to determine if it is friable; thorough watering of all exposed cut areas during excavation in the Franciscan Complex; upwind and downwind monitoring for fibers; continuous misting of stock piles; and wetting and covering haul trucks carrying serpentine rock. Disposal of any spoils containing asbestos would be at a certified facility (see Chapter VII, Mitigation Measures under Air Quality for dust control [Measure H-3] and under Hazardous Materials for disposal [Measure F-10]).

Soil Corrosivity

If groundwater is present, the majority of the soils in the areas of the RWTP, reservoirs, and distribution/transmission pipelines, exhibit a moderate to high potential to corrode piping, supports, pilings and utility lines because of their salinity, alkalinity, or poor drainage properties. More recent, imported soils tend to have more favorable characteristics than native soils, such as better drainage. A corrosion control study[3] evaluated corrosivity of soils at the Zoo and Golden Gate Park and determined that existing soil conditions at the Zoo and park sites are moderately corrosive to unprotected ferrous metals. Site-specific sampling would be required to evaluate the corrosivity of the soils and if corrosive conditions are present, the RWTP, reservoirs, and pipelines would need to be constructed of corrosion resistant materials or other corrosion control techniques could be employed (see Chapter VII, Mitigation Measure E-1).

Poor Drainage and Ponding

If soils in areas where proposed pipelines and structures would be located have poor drainage characteristics, the project sites could be prone to ponding. If excavations are not properly backfilled and graded, water could collect, causing settlement of soils and damage to facilities, particularly pipelines. Standard design measures to ensure proper drainage of all proposed facilities, as recommended in the geotechnical report, would be implemented to prevent ponding and associated impacts to facilities. Such measures could include removal and replacement of soils with poor drainage.

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[3] CH2M Hill, 1995. Recycled Water System Corrosion Control. Technical Memorandum prepared for the San Francisco Department of Public Works, June 26, 1995.

A.6 HAZARDOUS MATERIALS

Introduction

The following impact analysis is organized by issue area, according to the various impacts associated with potential exposure to hazardous materials during construction and operation of the RWMP. Under each issue, general, program-level types of impacts that could be applicable to any of the facilities are discussed first, followed by more detailed site-specific information, where available, on individual project sites.

Exposure to Subsurface Contaminated Materials During Construction

Hazardous materials have been and are commonly used in commercial, and, to a limited extent, residential areas. If improperly handled, stored, discarded or otherwise managed, they can result in public health or environmental hazards through contamination of soils or groundwater or through airborne releases in vapors, fumes, or dust. Excavation or other earthmoving associated with construction activities can result in the exposure of construction workers and the surrounding community to hazardous substances at sites where hazardous materials have historically been improperly handled, stored or discarded and resulted in soil or groundwater contamination.

Dewatering at the RWTP or reservoir sites could also result in exposure of construction workers or the public to hazardous materials if the groundwater has been contaminated. This water may be discharged to the City sewer system if it meets appropriate discharge requirements of the City's Industrial Waste Ordinance (see Groundwater and Surface Water Impacts, Section V.A.2, Construction Impacts, pp. 268 to 272). Otherwise, if the water is affected by hazardous materials, on-site treatment or off-site disposal of the water at a certified facility may be required. If excavated soil is classified as hazardous, on-site treatment or off-site disposal at a certified facility would also be required. In addition, the Franciscan complex bedrock which may be encountered at the RWTP plant and reservoir sites (see Geology, Soils, and Seismicity, Setting, Section IV.E, pp. 191 to 203) commonly contains serpentine, an asbestos containing mineral. If asbestos is present, special handling and disposal requirements may be imposed for excavation of bedrock.

Proposed construction activities that may result in hazardous materials being encountered include clearing and grubbing; structural and trench excavations for the treatment plant, reservoirs, and transmission/distribution pipelines; and dewatering. In addition to potentially

exposing construction workers and the community to hazardous materials, these construction activities could result in further contamination if the materials encountered are not properly handled. If previously unanticipated hazardous materials are encountered, project schedule delays could also occur due to regulatory requirements for site characterization and remediation. If the potential presence of hazardous materials is evaluated prior to construction, exposure to hazardous materials during construction can be managed and project schedules can be developed to incorporate the appropriate time required for site characterization and remediation activities, if necessary.

Section IV.F, Hazardous Materials (p. 204), presents a summary of current and historical land uses at each of the proposed RWMP facility sites. It also includes a description of known or potentially contaminated locations in the immediate vicinity of each site, as indicated by a computerized record search of regulatory agency listings conducted in January 1995. This information is used to assess the current potential for encountering hazardous substances during construction at each of the project sites, as discussed below. An updated review of regulatory agency listings would be conducted at all sites prior to construction, see Chapter VII, Mitigation Measure F-1.

If the site history indicates a potential source of hazardous materials at a project site, or a potential off-site source of hazardous materials has been identified, a site investigation would be necessary before construction to confirm the presence or absence of hazardous materials. If hazardous materials are identified, the regulatory agencies would need to be notified and further site characterization and remediation may be required. A site health and safety plan and a sampling and investigation plan would be required, and if necessary, a hazardous materials disposal and remediation plan would be required (see Chapter VII, Mitigation Measure F-4).

Previously unidentified hazardous substances could be present at the site resulting from migration of groundwater plumes from off-site sources or from on-site sources that have not been previously identified or characterized. The potential for this is low based on the site histories conducted for this report as well as the review of potential off-site sources.[1]

Nevertheless, if previously unidentified hazardous substances are identified during construction of the proposed project, exposure of workers and the community to hazardous materials could

[1] Orion Environmental Associates, *Hazardous Waste Background Report for the Recycled Water Master Plan and Groundwater Master Plan*, prepared for the San Francisco Department of Public Works and Water Department, December 1995.

occur through inhalation of vapors or fumes, through dermal contact with contaminated materials, or through direct or indirect ingestion of contaminated dust. The degree of any public health impact associated with the hazardous substances would depend on the nature and extent of any hazardous substances encountered and the management of these substances. Sampling would be necessary to identify the hazardous substances present, and it would be necessary to notify the regulatory agencies if hazardous materials are encountered. Contingency plans for encountering hazardous materials during construction and site safety plans to protect public health would be recommended for all sites (see Chapter VII, Mitigation Measures F-3 and F-4).

Recycled Water Treatment Plant - Fleishhacker Pool Site

Construction of the proposed recycled water treatment plant (RWTP) at the Fleishhacker Pool site would involve about 47,200 cubic yards of excavation, to a depth of about 20 feet below ground surface. There are two potential sources of hazardous materials that have been identified that may be encountered during construction. The first source is the former pool at the Fleishhacker site, which was filled with construction debris, including possibly abandoned cars. Excavation and earthmoving activities at the site of the former pool would expose the fill material, and it is unknown but possible that hazardous materials may be present.

The second source is contaminated groundwater from the nearby former Chevron service station site at the Great Highway and Sloat Boulevard where previously there was an underground storage tank leak. Although remediation efforts at this site have been completed, ongoing monitoring is continuing as part of the site closure process. The monitoring data indicate that there is still contamination present in the groundwater. Groundwater flow at the former gas station site is towards the southwest, and the Fleishhacker Pool site is located in the direction of groundwater flow from the previous gas station.[2] Ongoing groundwater monitoring indicates that in August of 1995, groundwater from monitoring wells located within the center island on Sloat Boulevard contained dissolved petroleum hydrocarbons at concentrations up to 53 milligrams per liter as well as detectable levels of benzene, toluene, ethylbenzene, and xylenes. However, these compounds were not identified in 1995 in the furthest downgradient monitoring wells located between the former service station and the Fleishhacker Pool site. Construction dewatering may cause accelerated migration of contaminants and possibly, migration of contaminated groundwater from the former service station site to the Fleishhacker Pool site. A

[2] Albert Lee, San Francisco Department of Public Health, Case Officer for 2940 Sloat Boulevard Chevron Station. Telephone communication with Mary McDonald, Orion Environmental Associates, November 29, 1995.

specific groundwater sampling program would be required during construction dewatering at the Fleishhacker Pool site to monitor for migration of contaminants (see Chapter VII, Mitigation Measure F-14).

Reservoirs

Construction of the proposed reservoirs would require excavation to a depth of about 28 to 32 feet below the ground surface. The anticipated volume of soil to be excavated ranges from 94,000 to 140,000 cubic yards (see Table 8, p. 68). Of the two proposed reservoir sites, potential on-site sources of hazardous materials were only identified at the Lincoln High School site, based on the record search and review of historical land uses. The review of historical aerial photographs indicated that in 1938 there were some industrial-type storage containers around a warehouse building at the site, prior to construction of the school. No other potential sources of hazardous materials were identified within two blocks of the Lincoln High School site. A site investigation including soil sampling would be conducted at the site under the direction of the Department of Public Health to determine if previous land uses have resulted in hazardous materials in the subsurface materials (see Mitigation Measure F-12). If hazardous materials are identified in the soil samples, the regulatory agencies would be notified, and additional site characterization and remediation, if necessary, would be conducted in accordance with applicable regulations (see RWMP Mitigation Measures F-4, F-5, and F-6).

There were no known or suspected potential on-site sources of hazardous materials identified at either of the proposed reservoir sites in McLaren Park. Both sites within McLaren Park are also located in areas well away from known or suspected off-site sources of potential contamination. Encountering hazardous materials during construction at these sites would not be likely.

Transmission and Distribution Pipelines

The proposed transmission/distribution pipelines for the RWMP would be installed in open trenches, generally within roadway rights-of-way, that would be excavated to a maximum depth of 8 feet. Due to the extent of development in the City and range of previous land uses, there would be a potential to encounter contaminated materials in the soils, particularly where the trenching would occur close to contaminated sites.

Two potential sources of hazardous materials were identified along the vicinity of the transmission pipeline route from Fleishhacker Pool site to the Lincoln High School reservoir site

to 19th Avenue as part of the computerized record search of regulatory agency listing conducted in January 1995. Both sites are fuel service stations with reported leaking underground storage tanks: a Super 7 Service Station located on 19th Avenue and Santiago Street, immediately along the proposed pipeline alignment, and a Shell service station located at 19th Avenue and Taraval Street, one block south of the proposed pipeline route.

In 1985, three gasoline underground storage tanks were removed from the Super 7 site. The maximum concentration of hydrocarbons identified in the soil samples from the underground storage tank excavations was 12 milligram per kilogram of total petroleum hydrocarbons. On the basis of this concentration, the SF Department of Public Health required no further action. Therefore, it is unlikely that this Super 7 site would affect soil or groundwater quality in the pipeline route.

In 1991, one 30-gallon underground storage tank and associated piping were removed from the Shell service station and three 8,000-gallon underground storage tanks were abandoned in place by cleaning them and filling them with gravel. During the removal of pipelines and the 30-gallon tank, total petroleum hydrocarbons as gasoline were identified in the soil at concentrations up to 19,000 milligram per kilogram, and benzene was also identified at concentrations up to 11 milligram per kilogram. The SF Department of Public Health required further sampling to characterize the vertical extent of hydrocarbons in the soil in the vicinity of the service station pipelines and abandoned underground storage tanks. A work plan for additional investigation was submitted to the SF Department of Public Health in September 1995. The work plant indicated that the horizontal extent of hydrocarbons in the soil has been characterized and is contained within the property limits. Therefore, this site would not be expected to affect soil quality in the proposed transmission pipeline route one block to the north because hydrocarbons present in the soil do not extend off site.

Groundwater quality at this Shell station site has not been addressed. Groundwater flow directions at this site are expected to be towards the west, away from the pipeline construction. Even if groundwater quality were affected at this site, it would not be expected to affect pipeline construction, since the depth of pipeline installation would be less than eight feet below ground surface.

Thus, encountering hazardous materials during construction along the proposed transmission pipeline route from the RWTP site to Lincoln reservoir site to 19th Avenue would not be likely. Mitigation measures proposed as part of the project would include updating the status of known

or suspected hazardous waste contamination, informing construction contractors of the potential to encounter hazardous waste contamination, and requiring the contractor to have a contingency plan to be implemented in the event that hazardous waste contamination is encountered (Chapter VII, Mitigation Measures F-1, F-2 and F-3). Implementation of these measures would minimize any impacts to public health in the event that hazardous waste contamination is encountered along the pipeline route.

Hazardous Building Materials Encountered During Demolition

Construction of the RWTP would involve demolition of the Fleishhacker Bath House. Due to the age of the building, it is possible that lead-based paint and asbestos-containing building materials that may be present. Prior to demolition of the Bath House, the Department of Public Works would conduct an audit for hazardous building materials and any recommendations for asbestos abatement and removal of hazardous materials would be implemented (see Chapter VII, Mitigation Measure F-11). This would eliminate any potential for construction workers or the public to be exposed to hazardous building materials during construction of the RWTP.

Operational Use of Hazardous Materials

The proposed recycled water treatment plant would utilize various chemicals as part of the recycled treatment process. These would include alum, caustic soda, polymer, phosphoric acid, sodium hydroxide, and sodium hypochlorite. Alum and caustic soda would be the only chemicals delivered in bulk to the RWTP (about 4,500 gallons per 14 day use for alum, and about 9,300 gallons per 14 day use for caustic soda); the other chemicals would be stored at the Oceanside Water Pollution Control Plant (WPCP) and transported to the RWTP as needed. Delivery of sodium hypochlorite would be through an existing pipeline between the Oceanside WPCP and the Westside Pump Station.

These chemicals are common chemicals used in water and wastewater treatment. Hazardous materials handling and storage would be similar to that at the Oceanside WPCP, as regulated under the Hazardous Materials Release Response Plans and Inventory Law. This law requires any business that handles over 500 pounds of hazardous materials prepare a Hazardous Materials Business Plan for emergency response to a release or threatened release of a hazardous material and for employee training. Compliance with hazardous materials transportation, storage and handling regulations and worker safety regulations would minimize any potential public health

concerns (including accidental or unauthorized releases) regarding the proposed use of hazardous materials at the RWTP.

The proposed RWTP and the pump station at the Lincoln High School reservoir site would also utilize a back up power generator to supply electricity in the event of a power outage. Backup generators typically use diesel which would be stored in an underground storage tank. Regulations regarding the underground storage of fuel products are contained in Title 23 of the *California Code of Regulations*. To comply with these regulations, the Department of Public Works would need to obtain a permit to construct and install the tank and piping system, to operate the tank, and to conduct leak detection monitoring in accordance with an approved monitoring plan. These measures would reduce the potential for an undetected release of diesel from the underground storage tank.

A.7 TRANSPORTATION AND CIRCULATION

Introduction

The following impact analysis is organized by impact topic with the impacts associated with each specific site or type of facility listed under the topic. All facility projects that are specified in the RWMP are analyzed on a detailed project-level basis, except various transmission and distribution pipelines. For those pipelines which do not yet have defined alignments, this section provides a general program-level traffic impact analysis that frames the impacts expected within a general pipeline corridor (several blocks wide). Future project-level environmental review will be completed when specific pipeline alignments are determined. No traffic impacts would result from overall operation of the recycled water system.

Construction-Related Trip Generation

Trip generation for each of the project components associated with construction of the proposed recycled water treatment plant and reservoirs, and related transmission pipelines, is summarized below. This information is based on the construction scenario details presented in Chapter III, Project Description (pp. 60 to 67).

Recycled Water Treatment Plant - Fleishhacker Pool Site and Reservoirs

Vehicle trips generated at the RWTP and reservoir sites would primarily consist of construction-related worker trips and truck movements to and from these sites. Peak daily and peak hour vehicle trips associated with construction at the RWTP and reservoir sites are presented in Table 28 below.

Transmission and Distribution Pipelines

Traffic generated by installation of the proposed transmission and distribution pipelines would consist of worker trips, trucks hauling materials to and from the site, and equipment delivery traffic (including delivery of pipe). The number of workers at any one site would vary substantially depending upon the type of construction activity and project. Based on estimates of manpower per task and the experience of similar construction projects, there would be approximately 6 to 12 workers per crew on an average day.

TABLE 28: PEAK DAILY AND PEAK HOUR VEHICLE TRIPS GENERATED BY CONSTRUCTION AT RECYCLED WATER TREATMENT PLANT AND RESERVOIR SITES

	Peak Daily Vehicle Trip-Ends			Peak Hour Vehicle Trip-Ends		
Location	Construction Worker	Trucks	Total	Construction Worker	Trucks	Total
RWTP						
Fleishhacker Pool	88	100	**188**	35	10	**45**
Reservoirs						
Lincoln High School	63	60	**123**	25	6	**31**
McLaren Park	63	60	**123**	25	6	**31**

SOURCE: Montgomery Watson, 1995 and Environmental Science Associates, 1995.

The approximate trench size to accommodate the transmission and distribution pipelines would be approximately 2.5 to 6 feet wide and 4 to 8 feet deep. It is assumed approximately 50 percent of excavated trench soil would be hauled off-site (and 50 percent would be re-used), and approximately 25 percent of the trench volume would be replaced with imported backfill. Cut-and-cover activities would be expected to proceed at an average rate of 50 to 100 feet per day.

Based on the estimated amount of material that would be excavated and filled along the pipeline segments, plus estimates of daily materials delivery and construction workers, up to 30 daily worker vehicle trips ends, and up to 22 daily truck trip ends (11 truck loads) would occur. Of these daily trips, approximately 12 worker vehicle trips, and approximately 3 truck trip ends would occur during each of the peak hours.

Construction-Related Traffic

Temporary project-related off-site transportation impacts on City roadways would result from construction workers and truck movements to and from the RWTP and reservoir sites. Potential effects to the transportation systems serving each of the facilities are presented below.

Recycled Water Treatment Plant - Fleishhacker Pool Site

The primary off-site impacts from the movement of construction trucks would include short-term and intermittent lessening of roadway capacities due to slower movements and larger turning radii of the trucks compared to passenger vehicles. Lane blockage due to queued trucks, if it were to occur, would temporarily reduce the roadway capacity of the affected streets. As identified in Section IV.G, Transportation and Circulation Setting (p. 209), freeways, major arterials, and secondary arterials (including I-280, 19th Avenue [SR 1], Skyline Boulevard [SR 35], Lake Merced Boulevard, Brotherhood Way, and Sloat Boulevard) are proposed to be used as haul routes to the extent possible (these haul routes are shown in Figure 56, p. 211). The use of these routes would minimize the project's effect on traffic flow in the project area. It should be noted that the specific haul routes would be designated after consultation with the City Department of Parking and Traffic and with Caltrans.

RWTP construction is projected to occur over a 24-month period. The greatest amount of project traffic, particularly truck traffic, would occur during the first half of the period during the work phases that include earthwork/grading, foundation and structural construction. During the second half of the construction period, the work involves equipment installation, utilities works, and operation set up which generate less construction traffic. Depending on the scheduling of construction activities at the RWTP and Lincoln High School reservoir site, there may be cumulative truck traffic increases on the major thoroughfares accessing both sites associated with concurrent construction of the two facilities

The amount of traffic generated by RWTP construction activities is estimated to be 188 total daily trips (100 truck); and 45 total peak-hour trips (10 truck). Even during the peak construction period, this additional traffic would not be substantial relative to background traffic conditions on the above thoroughfares. Project-generated traffic would be dispersed throughout the day, thus, minimizing the effect on peak-hour traffic, including transit. The effect of the project-generated trips would likely be felt most on the Great Highway which serves several recreational areas; however, the distance project construction trucks would travel on this roadway is relatively short.

Project truck traffic occurring during the hours of 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. would coincide with peak-hour traffic and could impede traffic flow. Blockage during times of peak traffic flow would have greater potential to create conflicts than during non-peak hours because of the greater numbers of vehicles on the streets during the peak hour that would have to

maneuver around the queued trucks. Restricting truck traffic during the a.m. and p.m. peak periods would minimize disruption of the general traffic flow on affected roadways during the a.m. and p.m. peak hours.

Mitigation measures are identified to reduce the effect of construction-generated traffic impacts (see Chapter VII, Mitigation Measures G-1 to G-6). These include the preparation of a Transportation Management Plan prior to construction that would be approved by the City to establish specific construction details, including the provision for restriction of truck traffic during the a.m. and p.m. peak periods; other mitigation includes requiring the project construction contractor to coordinate with construction contractor(s) for any concurrent nearby projects that could arise.

RWTP construction is not expected to occur at the same time as other proposed projects at the Zoo. As discussed in the Section IV.A, Land Use Setting (p. 112) and shown in the Zoo project schedule in Figure 39 (p. 123), construction of the proposed Zoo infrastructure improvements is scheduled to be complete before RWTP construction begins. Construction of the proposed new Zoo entrance and visitor parking area within the Fleishhacker pool site, if ultimately approved, would be scheduled to follow RWTP construction. Thus, this area would experience some cumulative construction traffic impact since construction would be occurring in the Fleishhacker pool area for 3 to 4 years. However, none of these projects is projected to generate substantial construction traffic. In addition, the Fleishhacker site and other areas on the Zoo property provide ample area for on-site construction materials storage and staging and truck parking, such that streets around the site would not be used for these activities.

Lincoln High School Reservoir Site

Reservoir construction at this site would be completed on an expedited 8-month schedule. As identified in Section IV.G, Transportation and Circulation Setting (p. 209), freeways, major arterials, and secondary arterials (including I-280, 19th Avenue [SR 1], Skyline Boulevard [SR 35], and Brotherhood Way) are proposed to be used as haul routes to the extent possible (these haul routes are shown in Figure 56, p. 211). The use of these routes would minimize the project's effect on traffic flow and operations in the project area.

The amount of traffic generated by construction activities, even during the peak construction period (123 total daily trips [60 truck]; 31 total peak-hour trips [6 truck]), would not be substantial relative to background traffic conditions on the above thoroughfares. Project-

generated traffic would be dispersed throughout the day, thus, minimizing the effect on peak-hour traffic, including transit. The effect of the project-generated trips would be felt most on the two-lane local roadways serving the construction sites, including Rivera Street, Santiago Street, Taraval Street, and 18th Avenue. Depending on the scheduling of construction activities at the RWTP and Lincoln High School reservoir site, there may be cumulative truck traffic increases on the major thoroughfares accessing both sites associated with concurrent construction of the two facilities.

Mitigation measures are identified to reduce the effect of construction-generated traffic impacts (see Chapter VII, pp. 472 to 498). These include the preparation of a Transportation Management Plan that would be approved by the City to establish specific construction details, including the provision for restriction of truck traffic during the a.m. and p.m. peak periods. Other proposed mitigation includes limiting construction activity to the hours between 7 a.m. and 5 p.m. (Measure I-3), and requiring the project construction contractor to coordinate with construction contractor(s) for any concurrent nearby projects that could arise (Measure I-15).

McLaren Park Reservoir Sites

Reservoir construction at either Site 1 or 2 is anticipated to be completed within 12 months. As identified in Section IV.G, Transportation and Circulation Setting (p. 209), freeways and major arterials (including U.S. 101 and Bayshore Boulevard) are proposed to be used as haul routes to the extent possible (these are shown in Figure 57, p. 217). The use of these routes would minimize the project's effect on traffic flow and operations in the project area.

The amount of traffic generated by construction activities, even during the peak construction period (123 total daily trips [60 truck]; 31 total peak-hour trips [6 truck]), would not be substantial relative to background traffic conditions on the above thoroughfares. Project-generated traffic would be dispersed throughout the day, thus, minimizing the effect on peak-hour traffic, including transit. The effect of the project-generated trips would be felt most on the two-lane local roadways serving the construction sites, including Mansell Street.

Mitigation measures are identified to reduce the effect of construction-generated traffic impacts (see Chapter VII, pp. 472 to 498). These include the preparation of a Transportation Management Plan that would be approved by the City to establish specific construction details, including the provision for restriction of truck traffic during the a.m. and p.m. peak periods.

Other mitigation measures include limiting construction activity to the hours between 7 a.m. to 5 p.m., (Measure I-3).

Transmission and Distribution Pipelines

A temporary increase in construction vehicle trips would also be associated with construction of the transmission and distribution pipelines, including arrival and departure of construction workers, and transport of soil and materials to and from the construction sites along the pipeline alignments. It is assumed these trips would be made on the regional-serving and local streets closest to the particular day's work location. For the proposed transmission line connecting the RWTP to the Lincoln High School reservoir site, these roadways would include primary arterials such as Sloat Boulevard and 19th Avenue; local two-lane roadways would include Santiago Street and Taraval Street.

General pipeline construction activity is projected to generate up to approximately 30 work vehicle trips and 22 daily truck trips (11 truck loads). Of these daily trips, approximately 12 worker trips and 3 truck trips would occur during each of the peak hours. This limited amount of additional traffic would not result in adverse traffic congestion on streets used to access the pipeline construction sites.

Construction-Related Roadway Disruptions

Recycled Water Treatment Plant - Fleishhacker Pool Site and Reservoirs

Construction activity and staging associated with the proposed Fleishhacker RWTP site would be contained within these site and would not occupy public streets. Construction of reservoirs at the Lincoln High School site and Sites 1 or 2 at McLaren Park would result in closure of a one-block section of Santiago Street (between 22nd and 24th Avenues) and a section of John F. Shelley Drive, respectively. While direct through access on these streets would be disrupted, access to all areas would be maintained (although less convenient) by adjacent and intersecting streets. Local traffic at the Lincoln site would detour around this area to Taraval and Rivera Streets. At either Site 1 or Site 2 in McLaren Park, local traffic would detour using Mansell Drive, the other end of John F. Shelley Drive loop road, and additional roads outside the park.

Transmission and Distribution Pipelines

The RWMP proposes transmission and distribution pipeline installation in and across streets. The location of the proposed pipelines within the roadways would be dependent upon existing utilities under the roadway, and would be identified during the design phase of the project. The analysis provided in this EIR defines the curb-to-curb width of the street and subtracts a 12-foot-wide construction zone.

Table 29 presents pipeline installation effects on roads along the alignment of transmission pipelines connecting the RWTP to the Lincoln High School Reservoir site. Table 30 presents pipeline installation effects on roadway types that occur along other pipeline corridors identified in the Recycled Water Master Plan. These impacts are generally described below.

Existing transportation and circulation patterns in the vicinity of the proposed pipeline alignments would be temporarily disrupted by construction activities and heavy equipment use in city streets. Impacts related to pipeline construction would include direct disruption of traffic flows and street operations. Lane blockages or street closures during pipeline installation would result in a reduction in travel lanes and curb parking, and could result in the need for traffic re-routing. Public transit routes, and pedestrian and bicycle traffic would also be disrupted during construction. In addition, access to businesses and residences would be disrupted. Pipeline installation within roadways would proceed at an average rate of 50 to 100 feet per day; thus, identified impacts would be brief at any one location along the pipeline alignment. Special trenching techniques (i.e., jack-and-bore) would be utilized at intersections with major and secondary arterials (e.g., Sloat Boulevard or Sunset Boulevard) to prevent complete blocking of these roadways during construction.

Mitigation measures are identified to reduce the effect of these impacts (see Chapter VII, Mitigation Measures G-1 to G-8). These include the provision for construction on major roadways to be conducted during the off-peak traffic periods; the use of flaggers, cones and barricades to control traffic flow; advanced notification to the public and emergency service providers regarding location and scheduling of construction work; and maintaining transit service through temporary transit re-routing.

TABLE 29: PIPELINE INSTALLATION EFFECTS ON ROADS ALONG ALIGNMENT OF TRANSMISSION PIPELINE CONNECTING RECYCLED WATER TREATMENT PLANT TO THE LINCOLN HIGH SCHOOL RESERVOIR SITE

Pipeline Within Road	Pipeline Crosses Road	Roadway Disruptions /a/	Transit Disruptions /b/	Bicycle / Pedestrian Path Disruptions	Disruptions in Access to Adjacent Land Uses
45th Avenue		45th Avenue paved street width reduced to 28 feet. Two travel lanes may be maintained with removal of parking on one side of roadway. Parking may need to be removed on both sides of the roadway depending on alignment of pipeline within roadway.		Temporary disruptions to bicycle and pedestrian movement along and across roadways.	Residences, commercial establishments at Sloat Boulevard
	Sloat Boulevard, Wawona, Vicente, Ulloa and Taravel Streets	Intersections at Sloat and Taravel Streets potentially partially blocked during construction. Other intersections partially or completely blocked during construction.	Pipeline crosses MUNI Lines 18 and 23 (Motor Coaches) at Sloat Boulevard, L Line (Metro Rail) at Taravel Street	Pipeline crosses citywide bicycle routes on Sloat Boulevard, Vicente Street, and pedestrian crosswalks at Sloat Boulevard.	
Santiago Street		Santiago Street paved street width reduced to 38 feet. Two travel lanes may be maintained with potential for removal of parking on one side of roadway.		Temporary disruptions to bicycle and pedestrian movement along and across roadways.	Residences, schools, park
	44th to 37th Avenues, Sunset Boulevard, and 36th to 22nd Avenues	Intersections at Sunset Boulevard and 19th Avenue potentially partially blocked during construction. Other intersections partially or completely blocked during construction. Any construction within Sunset Boulevard could adversely affect traffic flow on this thoroughfare.	Pipeline crosses MUNI Line 29 (Motor Coach) at Sunset Boulevard, and Line 66 (Motor Coach) at 30th Avenue	Pipeline crosses citywide bicycle routes on 34th Avenue and 20th Avenue, and pedestrian crosswalk at Sunset Boulevard.	

/a/ Assumes 12-foot-wide construction zone in roadways.
/b/ See Table 21, p. 215, for additional information on transit lines.

SOURCE: Environmental Science Associates, 1995

TABLE 30: PIPELINE INSTALLATION EFFECTS ON ROADS ALONG ALIGNMENT OF TRANSMISSION AND DISTRIBUTION PIPELINE IN RECYCLED WATER MASTER PLAN

Roadway Type	Lanes	Roadway Width	Roadway Disruptions /a/	General Impacts /b/
Local Streets	2	paved width < 22 feet	Roadway closure.	• Temporary disruptions in access to adjacent land uses, consisting primarily of residential units, but also commercial establishments, schools, churches, and parks. • Temporary removal of bikeways, pedestrian walkways and crosswalks, causing disruptions to local pedestrian and bicycle traffic. • Disruptions to public transit routes which pipeline alignment extends along or crosses. • Temporary displacement of on-street parking.
	2	22 feet ≤ paved width < 32 feet	Construction may require roadway closure, or alternate one-way travel may be maintained with use of traffic controls and removal of parking along both sides of roadway.	
	2	32 feet ≤ paved width< 42 feet	Two travel lanes may be maintained with removal of parking on one side of roadway. Parking may need to be removed on both sides of the roadway depending on alignment of pipeline within roadway.	
	2	paved width ≥ 42 feet	Two travel lanes may be maintained with potential for removal of parking on one side of roadway.	
Major/Secondary Arterials	4 lanes	paved width ≥ 50 feet	Two to three travel lanes may be maintained with potential for removal of parking on one or both sides of roadway.	• Construction within or across primary and secondary thoroughfares would adversely affect traffic flow on these roadways. • Temporary disruptions in access to adjacent land uses, consisting of mix of commercial uses, including restaurants, retail stores, offices, but also residential units, industrial land uses, schools, churches, and parks. • Temporary removal of bikeways, pedestrian walkways and crosswalks, causing disruptions to local pedestrian and bicycle traffic. • Disruptions to local and major public transit routes which pipeline alignment extends along or crosses, requiring re-routing of transit routes, relocation of bus stops, etc. • Temporary displacement of on-street parking.
	4 lanes divided	total paved travel width > 66 feet	Three to four travel lanes may be maintained with potential for removal of parking on one side of roadway.	
	6 lanes divided	total paved travel width ≥ 86 feet	Five to six travel lanes may be maintained with potential for removal of parking on one side of roadway.	

TABLE 30: PIPELINE INSTALLATION EFFECTS ON ROADS ALONG ALIGNMENT OF TRANSMISSION AND DISTRIBUTION PIPELINE IN RECYCLED WATER MASTER PLAN (Continued)

Roadway Type	Lanes	Roadway Width	Roadway Disruptions /a/	General Impacts /b/
Recreational Strects	2 lanes	total paved width ≥ 32 feet	Two travel lanes may be maintained with potential for removal of parking on one side of roadway.	• Temporary disruptions in access to recreational land uses, including 3-Com Park (Candlestick Park) , Zoo, beaches, and trails. • Temporary removal of bikeways, pedestrian walkways and crosswalks, causing disruptions to local pedcstrian and bicycle traffic. • Disruptions to public transit routcs which pipelinc alignment extends along or crosses. • Temporary displacement of on-street parking.
	4 lanes divided	total paved width ≥ 64 feet	Three to four travel lanes may bc maintaincd with potential for removal of parking on one side of roadway. May require use of pavcd shoulders on recreational streets.	

/a/ Assumcs 12-foot-wide construction zone in roadways.
/b/ Impacts apply to roadway type irrcspcctive of roadway width.

SOURCE: Environmental Science Associates, 1995

Cumulative Construction-Related Trips and Roadway Disruptions

Construction for the proposed project is scheduled to begin in 1999 for Phase 1, 2005 for Phase 2, and 2010 for Phase 3. Construction of the RWMP facilities could conflict with construction associated with the proposed San Francisco Wastewater Master Plan Bayside Discharge project, although no schedule has yet been established for any component of the Bayside Discharge project. The Bayside Discharge project identifies construction of force mains and tunnels through portions of the residential and commercial areas of the Bayview, Bernal Heights, Ingleside, Lakeshore, and Ocean View districts; some of the alternative alignments are in the vicinity of the proposed pipeline corridors for the RWMP. Specific developments proposed near the RWTP site include a residential development located at the corner of Sloat Boulevard and the Great Highway, and numerous construction projects proposed within the San Francisco Zoological Gardens (see Section IV.A, Land Use and Visual, p. 112). Cumulative construction-related traffic impacts would depend on the timing of individual projects with coinciding locations that would be associated with the RWMP, Bayside Discharge project, and/or projects in the vicinity of the Zoo.

A.8 AIR QUALITY AND ODOR

Introduction

The following impact analysis is organized by topic, with the impacts associated with each site or type of facility listed under the topic. No program-level air quality impacts would result from implementation of the RWMP and overall operation of the recycled water system. Air emissions would be associated with each specific facility that would be constructed and operated according to the RWMP. All development projects that are specified in the RWMP are analyzed on a project-level basis. Undefined aspects of the RWMP are evaluated on a program-level basis and the only undefined aspects of the RWMP, as they relate to air quality, are the final locations of some of the pipeline alignments. Where pipeline alignments are specified, they are evaluated on a project-level basis. For air quality, the program-level impacts associated with undefined pipeline alignments (identified as corridors) are the same as the project-level impacts, i.e., the potential for air quality impacts due to project construction would be similar because all defined and undefined pipelines would be located along city streets where the type of construction and source-to-receptor distances would be similar. Program- and project-level air quality impacts associated with cut-and-cover construction are described under Transmission and Distribution Pipelines below. For pipeline corridors, future project-level environmental review will need to be completed when specific pipeline alignments are determined.

Construction-Related Air Emissions

Construction Scenario

Construction-related impacts of the project were evaluated based on a construction scenario that would reflect typical conditions that could be reasonably expected to occur. This scenario is described in detail in Chapter III, Construction Scenario (p. 60) and relevant information is presented as follows:

Construction Duration. Anticipated schedule for completion of project components is as follows:

Recycled Water Treatment Plant	24 months
Lincoln High School Reservoir	8 months
McLaren Park Reservoir	12 months
Transmission/Distribution Pipelines	1-2 weeks at any one location (progressing at 50 to 100 feet/day)

Of the total construction period for the RWTP, shoring and excavation is estimated to occur over the first 10 months, requiring about two months for each project component (tertiary filter, UV disinfection, etc.). For reservoirs, excavation and shoring would occur over approximately 2 months.

Equipment Operation. Construction is proposed to occur on weekdays only between 7 a.m. and 5 p.m., Monday through Friday at all sites except the Lincoln High School Reservoir site, which would implement the same hours but also operate on some Saturdays. Operation of construction equipment and trucks would be restricted to these hours and days.

On a typical day, construction equipment operations for project facilities would likely be as follows:

Reservoirs:
(1) 2 - 4 Diesel (200 hp) Tractors, Backhoes, Graders, or Loaders (operating/idling about six hours/day)
(2) 1 Crane (200 hp; operating eight hours/day)
(3) Various Haul, Concrete and Delivery Trucks (generating 25 (average) to 60 (peak) truck trips/day) at the Lincoln High School and McLaren Park reservoir sites.
(4) 2-3 Pickup Trucks (for deliveries, superintendents, etc.)

RWTP:
(1) Same as Reservoirs except higher peak truck traffic (20 (average) to 100 (peak) truck trips/day).

Pipelines:
(1) 1 Diesel (200 hp) Backhoe (operating most of the day)
(2) 1 Diesel (200 hp) Boom Truck with Crane Behind for Setting Pipe.
(3) 1 Diesel Compactor (5 hp)
(4) 1 Haul Truck
(5) 1 Paver

Actual truck haul routes would be determined by the San Francisco Department of Parking and Traffic at the time of construction.

Construction-Related Dust and Equipment Exhaust Emissions - General

Construction activities associated with the project would generate dust (including the respirable fraction known as PM_{10}). Excavation activities associated with development of the project would entail substantial earth disturbance and potential dust generation. Dust emissions would be associated with a variety of activities, such as construction of underground storage reservoirs, cut-and-cover pipeline installation, and waste material transport/storage/disposal. These activities could result in localized dust nuisances near the activity.

In addition to dust, combustion emissions from construction equipment and vehicles, such as delivery trucks, haul trucks, backhoes, trenchers, air compressors, and generators, would result during construction of the proposed project. Construction employee vehicles and on-site use of pick-up trucks and small vehicles would also result in air pollutant emissions, but the levels would be negligible compared to emissions from on-site heavy equipment and from transport trucks. Equipment exhaust contains both pulmonary irritants and hazardous compounds, which may affect sensitive receptors such as young children, senior citizens, or those susceptible to respiratory disease. The proximity of construction to residential areas would result in potentially unhealthful exposure of sensitive receptors to equipment exhaust.

Potential dust and exhaust emissions associated with the proposed project would vary with each project component and would be specific to each site. Dust and exhaust emissions (without mitigation) are estimated in Table 31 and described for each project component below.

To convert dust and exhaust emissions associated with construction activities into ambient air quality, the USEPA's SCREEN2 dispersion model was run in its area source option.[1] Since any localized impacts must be superimposed onto the background levels, background levels were derived from monitoring data collected in San Francisco. Gaseous emissions (CO, NO_x, and SO_x) were superimposed onto the annual observed maximum level. Since peak PM_{10} emissions already exceed the State standard on several days per year, addition of any local emissions would exceed the State standard and could exacerbate existing violations. In order to obtain a meaningful impact analysis relative to possible new violations, project PM_{10} emissions were, therefore, superimposed onto the average rather than the maximum level. The existing baseline air quality levels and the local impacts that could cause a violation of standards are as follows:

Background and Impact Criteria Concentrations ($\mu g/m^3$)

Pollutant	Background	Additional Amount Needed to Violate State Standard
CO	11,500	11,500
NO_x	150	320
SO_x	Negligible	655
PM_{10}	20	30

[1] Area source size assumptions were: 150 sq. meters for RWTP, 100 sq. meters for reservoirs, and 30 meters x 10 meters for pipelines. Because NO_x is mainly NO when first released, it was assumed that 10% of "fresh" NO_x was in its NO_2 form for which there is a clean air standard. Daily PM_{10} levels were calculated by assuming that construction occurs for 8 hours followed by 16 hours of inactivity.

TABLE 31: TOTAL ESTIMATED DUST AND EQUIPMENT EXHAUST EMISSIONS FOR PROJECT COMPONENTS

Project Component & Excavated Material Volume	Closest Sensitive Receptor	Estimated Criteria Pollutant ($\mu g/m^3$) Emissions (Without Mitigation)				Potential Violation (Background+Project)	
		CO	NO_2	SO_2	PM_{10} No Mit./With Mit.	Without Mitigation	With Mitigation
State Standard		23,000 (1-Hour)	470 (1-Hour)	655 (1-Hour)	50 (24-Hour)		
Background Level		11,500	150	Negligible	20		
Additional Amount Needed to Cause Violation of Standards		11,500	320	655	30		
RWTP (Fleishhacker Site) (1,500 cubic yards/day)	Existing residential 450 ft. to the north	76	15	13	23/12		
	Proposed residential on vacant lot 120 ft. to the north (only if completed prior to project construction)	100-119	20-24	17-20	30-36/15-18	PM_{10}	
	Children's Zoo/Barnyard, Animal Resource Center, and Sandhill Crane/Musk Ox Area 150-200 ft. to the east	100	20	17	30/15	PM_{10}	
	Gorilla World Exhibit 1,000 ft. to the southeast	57	12	10	18/9		
Lincoln Reservoir/ Pump Station (2,000 cubic yards/day)	Residential 100 ft. to the east	182	42	37	34/17	PM_{10}	
	School Playfield 50 ft. to the west	191	44	38	36/18	PM_{10}	
	School Classrooms 100 ft. to the northwest	182	42	37	34/17	PM_{10}	
	School Basketball Courts 150 ft. to the north	173	40	35	32/16	PM_{10}	
	McCoppin Square Park recreational uses adjacent to construction staging area & 200 feet south of reservoir site	158-214	36-49	32-43	29-40/15-20	PM_{10}	
McLaren Park Reservoir (Alternative Sites 1 and 2) (2,500 cubic yards/day)	Residential 250 to the west of Site 1	146	33	29	27/14		
	Amphitheater 600 ft. to the north of Site 2	99	23	20	18/9		
Transmission Pipelines (40 - 80 cubic yards/day)	Residential 10 to 25 ft. from curb lanes.	1,006-1,032	227-233	158-162	69-71/35	PM_{10}	PM_{10}

SOURCE: Geier & Geier Consulting, Inc., 1995

The model was run for a typical mix of construction equipment that would most likely be required for RWTP, reservoir, and pipeline construction (see Chapter III, Construction Scenario. p. 60). Emission factors used were compiled based on the equipment mix and assumed power levels over the specified number of hours. Truck idling emissions while queued at the site were also included in the emission factors. Fugitive dust emission factors were derived from an excavation operation (mining) which involved site grading, excavation, truck loading, and wind erosion. Emission factors and emissions data input for the SCREEN2 model for RWTP, reservoir, and pipeline construction are presented in Appendix C. SCREEN2 was run for a unit emission rate of 1 g/sec/m^2 with project emissions (as listed in emissions data input in Appendix C) ratioed to the unit rate. SCREEN2 produces a worst-case, one-hour impact prediction and does not include any provisions for chemical conversion of emitted air pollutants.

Calculation of the dispersion pattern for the anticipated mix of construction equipment using the SCREEN2 model (as presented in Table 31, p. 328) indicates that local equipment emissions would not result in Clean Air standards being violated at any of the sites, even if the maximum theoretical project impact coincides with the maximum background day. However, PM_{10} levels could temporarily exceed the State standard along the predominantly downwind side of the construction area. Violations of State PM_{10} standards (as indicated by a predicted local impact of 30 $\mu g/m^3$ or more) could extend 50 meters (approximately 165 feet) from the downwind edge (predominantly east) of the RWTP, reservoir, or pipeline construction areas (see Table 31). No violations of Federal standards would occur because a local impact of 130 $\mu g/m^3$ in conjunction with a 20 $\mu g/m^3$ background level would be required to exceed the Federal standard of 150 $\mu g/m^3$.

Violations of PM_{10} standards could pose health risks if PM_{10} is comprised of biologically or chemically active matter. For construction dust, the material is usually chemically inert. Unless construction is in rocky media where asbestiform or silicate particles are generated, potential health impacts associated with possible localized elevated PM_{10} levels would not be expected. However, it should be noted that the potential for encountering serpentine rock in excavation areas cannot be ruled out until detailed geotechnical studies at each site are completed. Serpentine rock may contain fibrous silicate minerals, primarily chrysotile or antigorite, and the variety chrysotile is the chief source of asbestos. Asbestos is an identified carcinogen capable of causing cancer through the inhalation of asbestos fibers. Not all serpentine rock, however, contains asbestos. Similar to other excavation projects that have been conducted throughout the City, contractors would be required to employ specific measures (e.g., special handling and disposal procedures) to minimize any potential impact from serpentine rock (see Section VII,

Mitigation Measure H-3, which addresses potential air quality impacts from construction activity in areas with serpentine rock).

In areas where naturally occurring asbestos is not a factor, impacts associated with fugitive dust would more likely derive from the sedimentation of heavier particulate matter rather than the indefinite suspension of lighter material (PM_{10}). Deposition of such material on parked cars, outdoor furniture or landscape foliage is primarily a nuisance. The perceptible downwind extent of such potential nuisance varies from project to project, but occurs in very close proximity to the construction area. On average, the primary deposition zone from an area of soil disturbance is within a few hundred feet downwind of the source. Therefore, the area of dust nuisance potential closely coincides with the area of possible violations of the State PM_{10} standard.

Dust suppression using a fine water spray mist trained on the dirt surface being excavated, into the truckbed during loading and hauling of excess soil, and into the trench or area being backfilled could measurably reduce fugitive dust emissions. The Project Sponsors have agreed to incorporate this and other dust control measures, such as covering haul truck loads and stockpiles, into the project to reduce project-related construction dust generation impacts (see Chapter VII, Mitigation Measure H-1, for all dust-control measures included). Emissions reductions of 50 percent are typically observed when dust suppression measures such as these are implemented. A 50 percent reduction would not necessarily completely prevent temporary localized violations of the ambient PM_{10} standard, but would reduce the frequency, magnitude, and areal extent of dust emissions.

Construction-Related Dust and Equipment Exhaust Emissions at Specific Sites

Recycled Water Treatment Plant - Fleishhacker Pool Site. Nearby sensitive receptors that could be affected by project-related dust (PM_{10}) emissions would include residential uses north of the site and the San Francisco Zoological Gardens to the east. Table 31 (p. 328) identifies sensitive receptors in proximity to the RWTP site and lists estimated PM_{10} concentrations in the vicinity of these receptors. As shown in Table 31, normal background levels of PM_{10} in the vicinity of the Fleishhacker RWTP site are 20 ug/m^3. It is estimated that an additional 30 ug/m^3 of PM_{10} would be generated by proposed project construction in the vicinity of the Children's Zoo and Animal Resource Center, which are located downwind of the site (see Figure 37, p. 120), if no dust suppression measures were implemented. The sum of background and project-generated PM_{10} shown in Table 31 indicates that without mitigation there would be a high potential for occasional violation of the State 24-hour PM_{10} standard of 50 ug/m^3, but not of the

Federal 24-hour PM_{10} standard of 150 ug/m^3 during construction. Out of the overall anticipated construction period of 24 months, the period with the highest potential for dust generation (e.g., excavation and shoring) is expected to occur during the first 10 months of construction. In addition, some of the excavated material would be stored on-site in stockpiles for later backfilling. These stockpiles would also be a source of dust emissions until backfilling is complete (expected to be completed by the 17th month of the 24-month construction period) Implementation of dust suppression measures included as part of the project (as outlined in Chapter VII, Mitigation Measure H-1) could reduce project-related PM_{10} emissions by 50 percent. With such measures, neither PM_{10} standard would normally be exceeded at adjacent sensitive receptor sites.

Between 1989 and 1994, the 43-mgd Oceanside Water Pollution Control Plant was constructed on a site located just south of the Fleishhacker site and southwest of the zoo. Among the concerns was increased dust (PM_{10}) during construction. Environmental compliance monitoring conducted during construction of the Oceanside facility indicated that even though the contractor operated the site water truck throughout the day, the sandy soils, windy conditions and large area of excavation and grading resulted in the State PM_{10} standard being frequently exceeded. Wind data indicated that, on average, winds die down in the fall, rise during the storm season, and increase strongly in April and May when the offshore high pressure zone and associated winds move into place. The problems with PM_{10} violations were attributed to a number of factors including lack of effort by the contractor to effectively implement dust control measures (e.g., continuous watering of the site by the site water truck did not occur, haul roads and the top of the berm/stockpile tended to dry out and become dusty, stockpiled materials were inadequately protected from winds) and reliance on PM_{10} monitoring rather than daily visual site inspection for determining compliance.[2] While mitigation measures listed in Chapter VII provide dust control measures similar to those included in the Oceanside project (but modified according to recommendations of the Oceanside Environmental Compliance Monitoring Program to help avoid some of the problems encountered during construction of that project), the potential for violations will be dictated more by the effectiveness of implementing these measures by the contractor and methods used to determine environmental compliance as established in the environmental compliance monitoring program.

As indicated above, with incorporation of mitigation measures, such dust generation would be a nuisance to surrounding properties within a few hundred feet of the site, depositing dust on

[2] Environmental Science Associates, *Oceanside WPCP Construction Project Final Environmental Compliance Summary Report, January 1989-December 1994*, November 1994.

foliage, parked cars, etc., but such dust generation is not expected to result in violations of State PM_{10} standard. Nuisance dust would primarily affect downwind zoo uses as well as residences on the parcel to the north, if they are constructed prior to the project. No adverse health impacts are anticipated assuming dust is effectively controlled.

Lincoln High School - Reservoir Site and McCoppin Square Park Staging. Nearby sensitive receptors that could be affected by project-related dust emissions would include school uses to the north, playfields to the west that could be used by the school when the football field is unavailable, residential uses to the east, and active recreational uses in the southeast corner of McCoppin Square Park that would remain open during project construction. Table 31 (p. 328) identifies sensitive receptors in proximity to the Lincoln High School site and lists estimated PM_{10} concentrations in the vicinity of these receptors. The sum of normal background PM_{10} levels and estimated project-generated PM_{10} shown in this table indicates that there would be a high potential for violation of the State 24-hour PM_{10} standard (but not the Federal standard) at downwind sensitive receptor sites (which are residences located to the east) during the excavation phase of project construction unless effective dust control measures are applied. Out of the overall anticipated construction period of 8 months, the period with the highest potential for dust generation (e.g., excavation and shoring) is expected to occur for about two months. In addition, some of the excavated material would be stored on-site in stockpiles for later backfilling. These stockpiles would also be a source of dust emissions through most of the construction period (until backfilling is complete which is expected to be completed during the next to the last month of construction). Implementation of dust suppression measures included as part of the project (as outlined in Chapter VII, Mitigation Measure H-1) could reduce project-related PM_{10} emissions by 50 percent. With incorporation of mitigation measures, such dust generation would be a nuisance to surrounding properties within a few hundred feet of the site, depositing dust on foliage, parked cars, etc., but such dust generation would not result in violations of State or Federal PM_{10} standards. Nuisance dust would primarily affect downwind residential uses. No adverse health impacts are anticipated assuming dust is effectively controlled.

McLaren Park - Reservoir Site. Nearby sensitive receptors that could be affected by project-related dust emissions at the McLaren Park site would depend upon which of the two possible sites is selected, and could include a 500-seat park amphitheater, residential uses, and three park play areas. Table 31 (p. 328) identifies sensitive receptors in proximity to the two possible McLaren Park sites and lists estimated PM_{10} concentrations in the vicinity of these receptors. The sum of normal background PM_{10} levels and estimated project-generated PM_{10} shown in this table indicates that there would be a low potential for violation of the State 24-hour PM_{10} standard of

50 ug/m^3 (but not the Federal standard) at these receptors during the excavation phase of project construction. Additionally, as the winds in San Francisco are generally from the west and southwest, the nearest residences, which are west of Site 1, are not downwind of the project site which would greatly reduce the potential for dust-related impacts at that location. Out of the overall anticipated construction period of 12 months, the period with the highest potential for dust generation (e.g., excavation and shoring) is expected to occur for about two months. Implementation of dust suppression measures included as part of the project (as outlined in Chapter VII, Mitigation Measure H-1) could reduce project-related PM_{10} emissions by 50 percent. With such measures, neither PM_{10} standard would normally be exceeded at these receptor sites.

Transmission and Distribution Pipelines. Excavation activities associated with cut-and-cover pipeline installation (which includes transport, storage, and/or disposal of trench spoils as well as removal and backfilling of soils) could result in localized dust nuisances near the activity. Table 31 (p. 328) presents estimated PM_{10} emissions that would be generated by cut-and-cover pipeline construction. The sum of background and project-generated PM_{10} shown in this table indicates that pipeline construction would pose a high potential for violation of the State standard (but not the Federal standard) for PM_{10}. These high PM_{10} levels can be attributed primarily to the close proximity of the residences to the pipeline construction area.

While most of the pipeline routes have not yet been determined, there are a few pipeline routes which are specifically proposed as part of the Master Plan. Cut-and-cover construction would occur along these routes and they include sections of Sloat Boulevard, 45th Avenue, and Santiago Street, all residential streets. Depending on the location of the transmission line within the street right-of-way, the closest distance between existing residences and the construction area could be 10 to 25 feet.[3] Residences located downwind and within 165 feet of the pipeline construction area could be subject to PM_{10} levels that exceed the State standard. However, it should be noted that elevated PM_{10} levels at any particular residence would occur primarily when excavation/ backfilling activities occur directly in front of that particular residence, which would be less than one week. Cut-and-cover construction would progress at a rate of 50 to 200 feet per day and various construction activities could occur in the vicinity of one location along the construction route for one to two weeks.

[3] This setback distance is based on the minimum required building setback of up to 15 feet (specified for applicable zoning designations in the City Municipal Code) plus approximately 10 feet for sidewalk and curb width.

Construction-Related Off-Site Truck Exhaust Emissions - General

Delivery and haul trucks would generate exhaust emissions while idling at the project sites as well as while traveling along haul routes. Possible haul routes associated with each project site are shown in Figures 56 and 57 (pp. 211 and 217). While exhaust emissions include reactive organic gases (ROG), nitrogen oxides (NO_x), respirable particulates (PM_{10}), and carbon monoxide (CO), CO is the only localized pollutant which would have the potential to adversely affect local air quality. The other pollutants associated with exhaust emissions undergo reactive processes that create secondary polllutants, such as ozone, and they would affect regional, rather than local air quality. Residential uses are located adjacent to a number of the identified streets. Truck exhaust emissions would increase microscale CO exposure at adjacent or nearby residences. Trucks, however, are not major pollutant emissions sources in that one truck generates the equivalent of three times the CO emissions of a car. CO emissions associated with construction equipment and truck traffic are estimated for each project component below.

Construction-Related Off-Site Truck Emissions Associated with Specific Sites

Recycled Water Treatment Plant - Fleishhacker Pool Site. Delivery and haul trucks would generate exhaust emissions while idling at the RWTP site (emissions from this source are estimated and evaluated based upon assumptions described above under Equipment Exhaust Emissions) as well as while traveling along haul routes. On a local level, receptors located along haul routes would be subject to increased CO exposure equivalent to 40 cars passing per hour or one car every one and one-half minutes.[4] CO exposure increases on the magnitude of one additional car per minute or less would not noticeably alter CO hourly exposure at any given receptor site along the haul route.

Regionally, truck traffic would generate exhaust emissions that would undergo reactive processes, creating secondary pollutants such as ozone. Daily emissions were calculated for RTWP construction and estimated emissions are presented in Table 32 below. Emissions estimates indicate that BAAQMD significance thresholds would not be exceeded and there would be a wide margin of safety (which would allow for daily variations in traffic levels).

[4] This estimate is based on a peak daily volume of 100 trucks over eight hours or 13 trucks per hour, which is equivalent to approximately 40 cars per hour (since CO emissions from one truck is equal to emissions from three cars) for the RWTP site.

TABLE 32: TRUCK EXHAUST EMISSIONS IMPACT ON REGIONAL AIR QUALITY

Project Component	Daily Exhaust Emissions in Pounds/Day			
	CO	ROG	NO_x	PM_{10}
RWTP (Fleishhacker Site)/a/	49	13	55	10
Lincoln Reservoir/b/	30	8	33	6
McLaren Reservoir/c/	30	8	33	6
BAAQMD Suggested Emissions Significance Thresholds	550	80	80	80

CO: Carbon Monoxide
ROG: Reactive Organic Gas
NO_x: Nitrogen Oxides
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Assumptions: 60^0F; 25 mph; all haul trucks would use diesel fuel; one-way travel distance = 20 miles x 100 daily trips (50 truckloads) = 2,000 daily truck miles.
/b/ Assumptions: 60^0F; 25 mph; all haul trucks would use diesel fuel; one-way travel distance = 20 miles x 60 daily trips (30 truckloads) = 1,200 daily truck miles.
/c/ Assumptions: 60^0F; 25 mph; all haul trucks would use diesel fuel; one-way travel distance = 20 miles x 60 daily trips (30 truckloads) = 1,200 daily truck miles.

NOTE: Based on EMFAC7F1.1 emissions and assumptions listed above for each project component.

SOURCE: Geier & Geier Consulting, Inc., 1995

Reservoirs. Delivery and haul trucks would generate exhaust emissions while idling at the construction site (analyzed above under Equipment Exhaust Emissions) as well as while traveling along haul routes. Locally, truck traffic would increase CO exposure along project haul routes by the equivalent of 23 cars passing per hour or one car every three minutes along the route to the Lincoln and McLaren sites.[5] CO exposure increases from the equivalent of one

[5] These estimates are based on a peak daily volume of 60 trucks over eight hours or 8 trucks per hour, which is equivalent to 24 cars per hour for the Lincoln and McLaren Park sites.

additional car per minute or less would not noticeably alter CO hourly exposure at any given receptor site along the haul route.

Regionally, truck traffic would generate exhaust emissions that would undergo reactive processes, creating secondary pollutants. Daily emissions were calculated for each reservoir site and estimated emissions are presented in Table 32 (p. 335). Emissions estimates for all reservoir sites indicate that BAAQMD suggested emissions significance thresholds would not be exceeded and that there would be a wide margin of safety (which would allow for daily variations in traffic levels). If truck exhaust emissions generated by construction of the Lincoln Reservoir occurs simultaneously with RWTP construction-related truck emissions, cumulative increases in criteria pollutants would occur. Regional air quality would not be significantly affected except for NO_x. Cumulative emissions would remain below BAAQMD significance thresholds for all criteria pollutants except NO_x. Implementation of Mitigation Measure H-4, requiring use of trucks with recent low-NO_x tune-ups, would reduce potential cumulative emissions to below the significance threshold.

Transmission and Distribution Pipelines. There are specific pipeline routes as well as more general pipeline corridors (within which specific routes would be selected at a later date) proposed in the RWMP. Specific streets and general areas that would be affected are identified in Section IV.G, Transportation and Circulation (p. 209). Sensitive receptors located along specific pipeline routes include residential uses along Sloat Boulevard, 45th Avenue, and Santiago Street (west of 19th). On a daily basis, there would be a limited amount of excavation and hauling of excess materials to off-site locations. As indicated in the above construction scenario, there would typically be one haul truck required for pipeline construction and this truck could make several haul trips over the day. Emissions from this truck over the day would not be expected to threaten BAAQMD significance thresholds for regional air quality impacts.

Cumulative Construction-Related Air Emissions

The Zoo Master Plan and the Zoo Infrastructure Master Plan both propose new facilities in the vicinity of the Fleishhacker RWTP site. Of the projects identified in the Zoo Infrastructure Master Plan in the vicinity of the RWTP site, none would occur during construction of the RWTP. Projects identified in the proposed Zoo Master Plan that could occur during RWTP construction include the Zoo Entry Plaza/Parking project, and North American / Children's Zoo and African exhibit improvement project. The Entry/Parking project would be located in the same area as the RWTP project, while the latter two projects are located immediately east

(within 200 feet) of the RWTP site. If construction of any these facilities were to take place at the same time as RWTP construction, then temporary cumulative air quality impacts could result. Until proposed improvements are more clearly defined, cumulative construction noise level increases cannot be quantified. However, simultaneous construction at these locations would result in greater area that could be disturbed (resulting in greater dust [PM_{10}] emissions) and more construction equipment being operated simultaneously (resulting in greater exhaust emissions). The proposed Zoo Master Plan is currently undergoing environmental review. As more detailed information about the possible construction scenario of that project is developed, cumulative construction-related air quality impacts will be discussed in more detail as part of the environmental review document for that project.

Construction-Related Odor Potential - General

During construction, some equipment may be continually operating while stationed at one location for extended periods of time. Such equipment may occasionally result in perceptible odors of diesel exhaust at nearby receptors. The mobile equipment (such as trucks, loaders, and backhoes) frequently changes position such that the exposure of any single receptor is short-term. Some equipment (such as generators or compressors), however, which is stationary for prolonged periods, may result in noticeable diesel odors, even if the equipment is well-tuned and there are no microscale violations of any ambient air quality standards. This odor is primarily due to unburned hydrocarbons in the exhaust fumes, as most other exhaust pollutants such as carbon monoxide, sulfur dioxide, and nitrogen oxides do not exhibit a strong odor at the concentrations predicted downwind of the equipment. The use of emulsified and liquid asphalt in paving operations would also be a temporary source of odor.

Operational Air Emissions - General

Operation of the proposed recycled water system would result in secondary emissions associated with electricity generation. Operation of the tertiary treatment facility and of pumps in pump stations would consume electricity. Electricity generation that occurs through the combustion of fossil fuels would generate air pollutants. However, much of PG&E electricity resources include power generation facilities that do not use fossil fuels or electricity generated outside the air basin or outside California; therefore, only a small proportion of project-related electrical consumption would create a secondary air quality impact within the air basin.

Operational Air Emissions at Specific Sites

Recycled Water Treatment Plant - Fleishhacker Pool Site. BAAQMD permits are typically required for point sources of effluent discharge to the air, or for air pollution control devices. In recycled water treatment facilities, the only facilities involving point source emissions are the diesel emergency generators. As emergency generators, they would only be in use on an infrequent basis. There are no emissions associated with the filters or UV disinfection system. As a stationary point source, the proposed facility would require an authority to construct permit and a permit to operate from the BAAQMD. This permit review process would ensure that all air emissions associated with the facility comply with applicable Clean Air standards.

Reservoirs and Transmission and Distribution Pipelines. There would be no direct air emissions associated with project reservoirs or pipelines. There would not be any vents along project pipelines where air emissions would be released. Operation of the water reservoirs and associated pump station would not require any BAAQMD permits.

Operational Odor Potential - General

No odor problems would be expected with operation of the proposed water system due to the enclosed nature of proposed facilities. Proposed facilities would involve the treatment and storage of recycled water. There are typically no odor problems associated with water that has undergone tertiary treatment (recycling) because residual biologically-active organisms that create malodorous compounds are killed by disinfection prior to discharge of the reclaimed water into the storage and distribution system. All proposed treatment, conveyance, and storage facilities would be located underground, which would reduce the potential for odor generation. All underground facilities would be vented at ground level, and odor impacts at these locations would not be expected unless there were long periods of time when there was no circulation of the reclaimed water. With a planned dynamic system of frequent cycling of the water, anaerobic conditions (which could generate odor) are not expected to develop.

At the RWTP site, odor problems would not be anticipated since the water entering the treatment plant has already undergone secondary treatment. While bleach odors could be associated with the use of sodium hypochlorite, the relatively small quantities that are proposed to be used would limit the potential for odor problems. Downwind sensitive receptors are identified in Table 31

(p. 328). At these distances and with typical atmospheric mixing associated with existing wind conditions, no odor problems would be anticipated.

A.9 NOISE AND VIBRATION

Introduction

The following impact analysis is organized by topic, with the impacts associated with each site or type of facility listed under the topic. No program-level noise impacts would result from implementation of the RWMP and overall operation of the recycled water system. All development projects that are specified in the RWMP are analyzed on a project-level basis. Undefined aspects of the RWMP are evaluated on a program-level basis and the only undefined aspects of the RWMP, as they relate to noise, are the final locations of some of the pipeline alignments. Where pipeline alignments are specified, they are evaluated on a project-level basis. For noise, the program-level impacts associated with undefined pipeline alignments (identified as corridors) are the same as the project-level impacts, i.e., the potential for noise impacts due to project construction would be similar because all defined and undefined pipelines would be located along city streets where the type of construction and source-to-receptor distances would be similar. Program- and project-level noise impacts associated with cut-and-cover construction are described under Transmission and Distribution Pipelines, pp. 352 to 353. For pipeline corridors, future project-level environmental review will need to be completed when specific pipeline alignments are determined.

Construction Noise - General

Construction associated with the RWTP site would result in short-term increases in noise. During project construction, there would be two primary sources of construction noise: (1) operation of construction equipment, and (2) truck traffic associated with hauling of excavated materials, concrete placement, and equipment/materials/supply deliveries. These construction noise sources and assumptions for estimating noise from these sources are described below.

Construction Scenario

Construction-related impacts of the project were evaluated based on a construction scenario that would reflect typical conditions that could be reasonably expected to occur. This scenario is described in detail in Chapter III, Construction Scenario (p. 60) and in Chapter V, Air Quality and Odor, Construction Scenario (p. 325).

Construction-Related Noise Levels- General

Construction Equipment. During construction, temporary noise increases would result from the operation of heavy equipment. The construction period would vary with each component of the project, ranging between 8 and 24 months. Construction noise levels would fluctuate depending on construction phase, equipment type and duration of use, distance between noise source and receptor, and presence or absence of barriers between noise source and receptor. To estimate probable noise impacts, typical equipment and construction techniques are assumed.

Construction noise sources range from about 76 to 88 dBA for most types of construction equipment at 50 feet from the source with slightly higher levels of about 88 to 91 dBA for certain types of earthmoving and impact equipment. Noise levels from pile drivers can generate noise peaks of approximately 101 dBA at 50 feet. The rate of attenuation is about six decibels (dBA) for every doubling of distance from a point source. Noise levels at 25, 50 and 100 feet from the noise source for several types of typical construction equipment and potential noise attenuation are shown in Table 33. The values in Table 33 represent noise generation while equipment is operating under load. Average noise levels over extended periods of time are somewhat lower as equipment cycles through periods of load interspersed with idle periods.

Trucks. Sensitive receptors located adjacent to project construction areas and along haul routes would be subject to truck noise during project construction for 10 hours per day (7 a.m. to 5 p.m.), five days per week (Monday through Friday) except at the Lincoln site which would be six days per week (Monday through Saturday). Truck volumes would vary with each project component and with each phase of development, although the highest levels of traffic would occur during the excavation and concrete placement phases of project construction. During other phases of construction, project-related truck traffic would be associated with equipment and supply deliveries, which would require fewer truck trips than the excavation and concrete placement phases.

Once trucks leave the project sites, their noise generation would be regulated by state law regarding permissible noise limits. State law precludes local jurisdictions from adopting vehicle noise standards different from state standards. Vehicle noise compatibility standards along city streets are generally expressed in terms of hourly averages, or a weighted 24-hour average. Truck noise depends upon vehicle speed, load, terrain and other factors. At slow speeds (25 to

TABLE 33: NOISE LEVELS AND ABATEMENT POTENTIAL OF CONSTRUCTION EQUIPMENT NOISE AT 25, 50 AND 100 FEET (in dBA)

Equipment	Noise Level at 25 Feet		Noise Level at 50 Feet		Noise Level at 100 Feet	
	Without Feasible Controls/a/	With Feasible Controls/a/	Without Feasible Controls/a/	With Feasible Control/a/	Without Feasible Controls/a/	With Feasible Controls/a/
Earthmoving						
Front Loaders	85	81	79	75	73	69
Backhoes	91	81	85	75	79	69
Dozers	86	81	80	75	74	69
Tractors	86	81	80	75	74	69
Graders	91	81	85	75	79	69
Trucks	97	81	91	75	85	69
Materials Handling						
Concrete Mixer	91	81	85	75	79	69
Concrete Pump	88	81	82	75	76	69
Crane	89	81	83	75	77	69
Derrick	94	81	88	75	82	69
Stationary						
Pumps	82	81	76	75	70	69
Generator	84	81	78	75	72	69
Compressors	87	81	81	75	75	69
Impact						
Pile Drivers	107	101	101	95	95	89
Rock Drills	104	86	98	80	92	74
Jack Hammers	94	81	88	75	82	69
Pneumatic Tools	92	86	86	80	80	74
Other						
Saws	84	81	78	75	72	69
Vibrators	82	81	76	75	70	69
City Noise Limit	92	92	86	86	80	80

/a/ Estimated levels obtainable by selecting quieter procedures or machines and implementing noise-control features requiring no major redesign or extreme cost (e.g., improved mufflers, equipment redesign, use of silencers, shields, shrouds, ducts, and engine enclosures).

SOURCE: US Environmental Protection Agency, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, December 1971.

30 mph), one truck makes the same level of noise as would be generated by 80 cars. At freeway speeds, one truck generates the same noise level as ten cars.[1]

The effects of potential truck noise intrusion would depend on the level of background noise already occurring at a particular receptor site. In quiet noise environments (Leq averaging 50 dBA), one truck would be noticeable. However, in slightly noisier environments (Leq averaging 60 dBA), the threshold level is higher and it would take 10 trucks per hour to noticeably increase the noise exposure. In moderately noisy environments (Leq averaging 70 dBA), the noise increase would be perceptible with the addition of 100 trucks per hour.[2] In quiet noise environments or during quieter times of the day, truck noise is mainly a single event disturbance because, although the hourly average associated with short single events is not very high, individual noise peaks of 80 to 85 dB are common during a truck passage. In noisy environments or during less noise-sensitive hours, truck noise would be perceived as a part of the total noise environment rather than as an individual disturbance.

Therefore, the overall noise impact of project truck traffic along haul routes would depend on the current level of truck traffic, frequency (or rate) of truck traffic over the day, the time of day it occurs, and proximity of sensitive receptors. In general, the greatest impact would occur on the narrower residential streets where residential setbacks are small and existing truck volumes are low.

Construction-Related Noise Levels at Specific Sites

Construction of proposed facilities associated with implementation of the RWMP would result in short-term noise increases. Construction of proposed facilities would require use of equipment similar to those listed in Table 33 (p. 342). Estimated noise levels (with and without feasible noise controls (as defined in Table 33, footnote a) at each specific site is outlined in Table 34 below. Feasible noise controls that are included as part of the project include use of best available noise control techniques, testing/monitoring of equipment, advanced noticing of residents, and limiting hours of construction (see Chapter VII, Mitigation Measures I-1 to I-8).

1 Caltrans, *Noise Technical Analysis Notes,* 1989 (from Calveno reference energy mean emission levels [REMELs]).
2 Derived from Caltrans, *Noise Technical Analysis Notes,* 1989.

TABLE 34: ESTIMATED CONSTRUCTION NOISE LEVELS AT SENSITIVE RECEPTORS

Project Site Controls/a/	Closest Sensitive Receptor	Estimated Exterior Noise Level at Receptor Without (w/o) and With (w/) Noise
RWTP Site (Fleishhacker)	Residential 450 ft. to the north	57 - 82 dBA w/o & 56 - 76 dBA w/
	Multi-family residential 120 ft. to the north (under construction)	68 - 93 dBA w/o & 67 - 87 dBA w/
	Children's Zoo/Barnyard, Animal Resource Center, and Sandhill Crane/ Musk Ox Area 150-200 ft. to the east	67 - 92 dBA w/o & 66 - 86 dBA w/
	Gorilla World Exhibit 1,000 ft. to the southeast	50 - 75 dBA w/o & 49 - 69 dBA w/
Lincoln High School Reservoir Site	Residential 100 ft. to the east	70 - 95 dBA w/o & 69 - 89 dBA w/
	School Playfield 50 ft. to the west	76 - 101 dBA w/o & 75 - 95 dBA w/
	School Classrooms 100 ft. to the northwest	70 - 95 dBA w/o & 69 - 89 dBA w/
	School Basketball Courts 150 ft. to the north	66 - 92 dBA w/o & 66 - 86 dBA w/
McLaren Park Reservoir Site (Alternative Sites 1 and 2)	Residential 250 ft. to the west of Site 1	62 - 87 dBA w/o & 61 - 81 dBA w/
	Amphitheater 600 ft. to the north of Site 2	54 - 79 dBA w/o & 53 - 73 dBA w/
Speech Interference Criterion		70 - 80 dBA

/a/ Noise controls are discussed in Table 33, footnote a. The highest noise levels (without and with noise controls) are attributable to impact pile driving. If impact pile driving does not occur, the listed noise levels would be 3 dBA lower than estimated levels without noise controls and 15 dBA lower than estimated levels with controls. If use of other impact tools such as rock drills and pneumatic tools does not occur, the listed noise levels would be 20 dBA lower than estimated levels with controls (which is the lower number of the listed range).

SOURCE: Geier & Geier Consulting, Inc., 1995

Pertinent Noise Standards and Criteria - General. Noise impacts at specific sites are determined by comparing construction-related noise levels at specific sites with the following applicable noise standards:

City Noise Standards. During the daytime hours (7 a.m. to 5 p.m.), the maximum noise level permissible during construction in the City is 80 dBA, when measured at 100 feet from the noise-generating equipment. Impact tools, pavement breakers, and jackhammers are exempt from this requirement. Although this standard is defined in terms of a noise limit at 100 feet, this standard can be adjusted for shorter distances such as 50 or 25 feet. It should be noted that noise attenuation rates at distances of less than 50 feet can vary due to localized effects such as noise reflection off building surfaces or noise shielding from adjacent buildings; these effects can cause noise levels to vary at any given location within this distance. When the standard attenuation rate for spherical spreading of sound waves from a point source of 6 dBA per doubling of distance is applied to the City noise limit, the equivalent City noise limit for construction equipment at 25 and 50 feet is 92 and 86 dBA, respectively. Corresponding standard construction noise levels at these distances are presented in Table 33.

When individual types of construction equipment are considered (as listed in Table 33), peak noise levels generated by the operation of all types of construction equipment could exceed the 80 dBA criterion at 100 feet if feasible noise controls are not implemented. With feasible noise controls, peak noise levels would not exceed the 80 dBA at 100 feet criterion (or corresponding criteria at shorter distances) except when pile driving equipment is operated. Although the 80 dBA criterion would be exceeded if pile drivers are used, it should be noted that noise impact tools are exempt from the Noise Ordinance limits.

Speech Interference Criteria. Noise peaks generated by construction equipment could result in temporary disturbance (e.g., speech interference) to persons in adjacent buildings if the noise level in the interior of the building exceeds 45-60 dBA.[3] A typical building can reduce noise levels by 20 to 25 dBA with the windows closed,[4] although the actual noise attenuation may vary depending on building construction and design. This noise reduction could be maintained only on a temporary basis in some cases since it assumes windows must remain closed at all times. Assuming a 20 to 25 dBA reduction with the windows closed, an exterior noise level of 70 to 80 dBA at receptors would maintain an acceptable interior noise environment for normal conversation. It should be noted that such noise levels would be sporadic rather than continuous in nature because different types of construction equipment would be used throughout the construction process.

Criteria for Zoo Animal Collection. The San Francisco Zoological Gardens lies immediately adjacent to the RWTP site to the east. During construction of the Oceanside Wastewater Treatment Plant immediately south of the Zoo and during construction projects associated with the Zoo, a substantial effort was made to identify and reduce the impacts of construction noise and vibration on zoo animals. The potential for long-term

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3 In indoor noise environments, the highest noise level that permits relaxed conversation with 100% intelligibility throughout the room is 45 dBA. Speech interference is considered to become intolerable when normal conversation is precluded at 3 feet, which occurs when background noise levels exceed 60 dBA. In outdoor environments, the highest noise level that permits normal conversation at 3 feet with 95% sentence intelligibility is 66 dBA (US Environmental Protection Agency, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety)*, March 1974.

4 US Environmental Protection Agency, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* March 1974.

and short-term adverse effects on the Zoo animal populations from the construction project were of major concern to Zoo staff. Monitoring of construction noise levels and of behavioral response of animals to noise and vibration during the construction of the Oceanside plant revealed that some Zoo animals (birds and gorillas) were sensitive to impulsive noise, particularly during the breeding season.[5] Examples of impulsive noise include jackhammers, drilling equipment, and truck back-up beepers. The monitoring also revealed that some animals do not appear to be affected by construction noise and vibration.

Criteria for the protection of Zoo animals from noise and vibration disturbance that were used for the Oceanside project[6] included a noise limit at site boundaries of 65 dBA (the ambient noise level at the time of project construction), measured as an hourly average (Leq), with a maximum of 70 dBA continuous daily exposure (representing a 5-dBA increase over the ambient), and 75 dBA for peak levels (Lmax, representing a 10-dBA increase over the ambient) during any one measurement. These criteria were intended to prevent effects upon animal health, including impacts to cardiovascular function, reproductive success and hearing ability.

Recycled Water Treatment Plant - Fleishhacker Pool Site. Construction of the proposed recycled water treatment facility would result in short-term increases in noise during the 24-month construction period. Construction of the proposed recycled water treatment facility would require use of equipment similar to those listed in Table 33 (p. 342). Maximum noise levels would depend on whether sheetpiles are driven or vibrated. If they are driven, annoying and repetitive noise peaks can result. Sonic or vibratory sheetpile drivers minimize the pounding noise, but cause vibration effects that can be annoying to some. Sheetpiles could be needed wherever excavation and shoring activities are proposed, which would include proposed below-ground structures such as the secondary effluent pump station, equalization basin, and clearwell storage reservoir. The basin and reservoir are proposed to be located near the eastern project boundary, adjacent to the Zoo.

Nearby sensitive receptors that could be affected by project-related construction noise would include residential uses north of the site and Zoo-related uses to the east. The closest sensitive receptors and estimated construction noise levels at these receptors are presented in Table 34 (p. 344). As indicated in this table, noise levels at existing residential receptors could reach 79 dBA without feasible noise controls or 61 dBA with controls (assuming no impact pile driving). Multi-family residences being constructed to the north would be subject to noise levels up to 90 dBA without or 72 dBA with controls (assuming no impact pile driving). With feasible noise controls (as defined in Table 33, footnote a, and as included in the proposed project in

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5 City and County of San Francisco, Planning Department, *Negative Declaration, San Francisco Zoo Infrastructure Replacement*, December 22, 1994.

6 Environmental Science Associates, *Oceanside WPCP Construction Project, Environmental Compliance Summary Report, January 1989 - December 1994,* November 1994.

Chapter VII, Mitigation Measure I-15), exterior noise levels (assuming no impact pile driving) would not exceed the 70 to 80 dBA speech interference criterion at the closest existing or future residences If impact pile driving occurs on the site, exterior noise levels would exceed the speech interference criterion at the nearest residential receptors. Table 34 (p. 344) indicates that noise levels at existing residential receptors could reach 82 dBA without feasible noise controls or 76 dBA with controls. Noise levels at future residential receptors at residences under construction to the north could reach 93 dBA without or 87 dBA with controls. However, it should be noted that pile driving would not be continuous, occurring at scattered intervals during the 4-6 month earthwork phase for periods of one to two weeks.

Construction at the RWTP site would cause noise and vibration increases above baseline noise levels which could disturb sensitive animals in nearby Zoo exhibits. Construction would involve both consistent and impulsive sources of noise and vibration. Figures 37 and 38 (pp. 120 and 122) present the layout of exhibits, facilities and uses at the Zoo under existing and future conditions. As shown in Figure 37 (p. 120), the existing Zoo exhibits adjacent to the RWTP site include the Children's Zoo/Barnyard, the Animal Resource Center, the Sandhill Crane/Musk Ox Area, all within 200 feet of the RWTP site, and the Gorilla World Exhibit, which is within 1,000 feet of the RWTP site. Estimated construction noise levels at these exhibits are presented in Table 34.

Without impact tools (including impact pile drivers, pneumatic tools, and rock drills), construction noise levels would reach 69 dBA at the site boundary assuming feasible noise controls are implemented. Construction would remain at least 100 feet from the Zoo boundary. Noise measurements taken in June 1996 at the RWTP site boundary indicates that the daytime Leq is 54 to 57 dBA, nighttime Leq is 53 to 54 dBA, and overall (24-hour) Leq is 53 to 56 dBA. With such low ambient noise levels at the site boundary, construction noise levels of 69 dBA would exceed the 5-dBA (Leq) and 10-dBA (Lmax) increase criteria at the site boundary. Construction of a noise wall could reduce noise levels by approximately 10 dBA at the nearest Zoo receptors if the wall is properly designed (see Chapter VII, Mitigation Measure I-15, for more information). A 10-dBA reduction would be adequate to maintain construction noise increases at or below the 5-dBA (Leq) noise increase criterion at the site boundary.

With pile driving, noise levels of up to 92 dBA without noise controls and 86 dBA with controls could occur at the Children's Zoo, while levels of 75 dBA without and 69 dBA with controls could occur at Gorilla World. Pile driving would result in noise levels that clearly exceed the Zoo 5-dBA and 10-dBA noise increase criteria at the site boundary and these criteria could also be exceeded at Gorilla World and the Children's Zoo (depending on actual ambient noise levels

at these exhibits). It should also be noted that use of jackhammers and impact pile drivers was strictly prohibited during construction of the Oceanside plant. Provision of a noise wall, implementation of a program to monitor zoo animals and prohibition of impact tools during construction at the RWTP site would allow the project to reduce potential construction noise impacts on the Zoo animal collection and maintain the 5-dBA (Leq) increase criterion (see Chapter VII, Mitigation Measure I-15).

The results of monitoring for internal zoo construction projects and for the Oceanside plant, as well as the zoo keeper surveys indicate that, of these nearby exhibits, the exhibits which could be affected by construction noise and vibration include the Children's Petting Zoo and Gorilla World. Monitoring by zookeepers during construction of the Oceanside plant indicated reactions including zebras stampeding due to unusually noise conditions, numerous instances of distressed and aggressive behavior of birds at the Avian Conservation Center, and gorillas displaying aggressive/agitated behavior during noisy earthwork.

The Avian Conservation Center has historically been located on the west end of the Zoo, within 200 feet of the RWTP site, and houses birds, some of which are of endangered status. The San Francisco Zoological Society has documented the sensitivity of birds of prey to noise through literature review and monitoring. In addition, a survey of zoo keepers was conducted regarding the impacts of construction upon animals. The survey resulted in the conclusion that the existing Avian Conservation Center would need to be relocated prior to commencement of the Zoo Infrastructure Project, in order to protect these sensitive birds from impacts of construction. In August of 1996, the Avian Conservation Center was permanently relocated to a site southeast of the RWTP site, as shown in Figure 37 (p. 120). The relocation of the Avian Conservation Center moved these sensitive birds more than 1,000 feet from the RWTP site, from which distance RWTP construction would not be of concern.

On the Oceanside project, the 5-dBA increase criterion was enforced by continuously monitoring noise levels at the site boundary (a fixed noise meter was posted at the Zoo fence line facing the construction site, and was operated continuously, 24 hours a day). Noise monitoring indicated that noise compliance was relatively good at the beginning of the construction job and throughout the period of plant construction, but during the period of initial sound berm construction and sound berm removal, the noise levels consistently violated the noise standard. Most of the noise violations occurred during the excavation phase, while the concrete pouring and internal structural work were generally quiet. While violations of the noise standard occurred during construction, they were generally attributed to truck routing, truck speeds or

specific pieces of equipment that were noisy. The violations were usually addressed by replacing the piece of equipment with a quieter one, reducing speeds, rerouting trucks, reducing the number of pieces of equipment, and/or limiting work hours. Complaint records from zoo staff suggest that the gorilla population was quite sensitive to earthwork noise at the beginning, but they became habituated to the noise activity over time.[7]

Delivery and haul trucks would generate noise while traveling along haul routes. A likely haul route associated with this site is shown in Figure 56 (p. 211). Truck noise increases would be most noticeable on residential streets which do not typically carry truck traffic, and the haul route associated with this site would generally avoid residential neighborhood streets, except for two sections along Lake Merced Boulevard. Residences fronting on Lakeshore Drive and Gellert Drive also face Lake Merced Boulevard, but they are separated from this street by the streets they front on. Noise levels from a passing truck could result in individual noise peaks of approximately 80 to 85 dBA at 50 feet from the roadway centerline at 25 and 55 mph, respectively, and interior noise levels due to a passing truck at residences could reach 60 to 65 dBA with the windows closed and 70 to 75 dBA with the windows open (assuming truck speeds of 25 to 55 mph). Such levels would not exceed the 70 to 80 dBA speech interference criteria (with windows closed).

Reservoirs. Construction of proposed reservoirs would result in short-term increases in noise. Construction of all reservoir sites would require use of equipment similar to those listed in Table 33 (p. 342). While such noise levels would comply with the City's 80 dBA noise limit (as discussed above under Construction Equipment, p. 341), the effect of such noise levels on adjacent or nearby sensitive noise receptors at each reservoir site is discussed below.

Lincoln High School. Nearby sensitive receptors that could be affected by project-related construction noise would include school uses to the north and west and residential uses to the east. The school would remain open during the 8-month project construction period. The closest sensitive receptors and estimated construction noise levels at these receptors are presented in Table 34 (p. 344). As indicated in this table, the closest school classrooms could be subject to noise levels of up to 92 dBA without noise controls or 74 dBA with controls (assuming no impact pile driving). The school playing fields/courts would be subject to noise levels of 88 to 98 dBA without or 70 to 80 dBA with controls, while residential uses would be subject to noise levels of 92 dBA without or 74 dBA with controls (assuming no impact pile driving). With noise

[7] Environmental Science Associates, *Oceanside WPCP Construction Project, Environmental Compliance Summary Report, January 1989 - December 1994,* November 1994.

controls, exterior noise levels would not exceed the 70 to 80 dBA speech interference criterion at the closest existing residences or classroom buildings. Interior noise levels of 54 dBA with the windows closed and 64 dBA with the windows open could be achieved in classrooms and residences. Based upon these project levels, it is expected that windows may need to be closed at times in order to minimize speech interference effects. However, if sheetpiles are driven rather than vibrated, exterior noise levels would exceed the speech interference criterion at classrooms and residences. Using vibratory pile drivers, coordinating pile driving activities with school schedules (preferably limiting pile driving to summer months when school is not in session), and/or constructing plywood barriers would help reduce construction noise impacts on school outdoor activities (see Chapter VII, Mitigation Measures I-9 to I-15).

During construction, the currently unused playing field west of the site could be used as an alternative sports activity site for the school. Since school sports activity on this field would be located outdoors, there would be no building attenuation benefits. Normal speech at a distance of 3.3 feet generates about 65 dBA. In quiet outdoor environments, normal speech can occur at distances up to approximately 16 feet (with noise levels of 45 to 50 dBA).[8] If background noise levels exceed 60 dBA, speech interference would occur at distances greater than two to three meters. Based on this criterion, speech interference could occur, at times, at the adjacent playfield and basketball courts, even with use of noise controls. It should be noted, however, that recreational uses are not typically considered to be sensitive receptors.

Delivery and haul trucks would generate noise while traveling along haul routes. Haul trucks would operate during the same hours as construction equipment, generally weekdays and some Saturdays between 7 a.m. and 5 p.m. Likely haul routes associated with the site are shown in Figure 56 (p. 211). Truck noise increases would be most noticeable on residential streets that do not typically carry truck traffic, which include Santiago Street, Rivera Street, and 18th Avenue. Use of haul trucks on Saturdays along residential streets would also be more noticeable to residents than weekday use, since there are typically more residents at home on Saturdays than on weekdays. Truck traffic on haul routes could reach 25 trips per day on average days and 60 trips per day on peak days (or up to 6 trips per hour during peak hours). Noise levels from a passing truck could result in individual noise peaks of approximately 80 dBA at 50 feet or 85 dBA at 25 feet from the roadway centerline (at 25 mph) and interior noise levels due to a passing truck at residences could reach 60 or 65 dBA with the windows closed and 70 or 75 dBA

[8] US Environmental Protection Agency, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* March 1974.

with the windows open. On wider streets where residences are setback 50 feet from the roadway centerline, such levels would not exceed the 70 to 80 dBA speech interference criteria (with windows closed). However, on narrower streets where residences are set back 25 to 30 feet from the roadway centerline, a passing truck could generate noise levels of 85 dBA, which could interfere with speech in rooms facing the street.

McLaren Park. Nearby sensitive receptors and park uses that could be affected by project-related construction noise would vary with two possible sites. The closest sensitive receptors to these sites and estimated construction noise levels at these receptors are presented in Table 34 (p. 344). As indicated in this table, noise levels at residences west of Site 1 could reach 84 dBA without or 66 dBA with controls (assuming no impact pile driving). With feasible noise controls, exterior noise levels would not exceed the 70 to 80 dBA speech interference criterion at the closest existing residences. Interior noise levels of 46 dBA with the windows closed and 56 dBA with the windows open could be achieved in residences (assuming no impact pile driving). At these levels, an acceptable interior noise environment for normal conversation could be maintained with the windows open or closed. If pile driving occurs on the site, exterior noise levels could exceed the speech interference criterion at residences. Park visitors using relocated pedestrian paths and picnic/play areas in the Site 1 vicinity would also be subject to construction noise. The extent of noise increase would depend on proximity to construction activities, and it is expected that park visitors would most likely relocate to other picnic areas and walking paths during the 12-month construction period.

At Site 2, park uses include the amphitheater located 600 feet to the north and walkers/joggers using several dirt paths that cross over and adjacent to the project site. The amphitheatre would be subject to noise levels of 76 dBA without or 58 dBA with controls (assuming no impact pile driving). With feasible noise controls, exterior noise levels would not exceed the 70 to 80 dBA speech interference criterion at the amphitheater. However, construction noise would disrupt any performances/events if they occurred during project construction. If pile driving occurs at this site, exterior noise levels could exceed the speech interference criterion at the amphitheater. Coordination of construction activities with scheduled park events will reduce potential noise compatibility problems with park uses (see Chapter VII, Mitigation Measure I-17). Proposed weekday construction at this site will help reduce potential scheduling conflicts with weekend park/amphitheater events.

Delivery and haul trucks would generate noise while traveling along haul routes. Possible haul routes associated with this site are shown in Figure 57 (p. 217). Truck noise increases would be

most noticeable on residential streets which do not typically carry truck traffic including the section of Mansell Street near the Park. Truck traffic on haul routes could reach 25 trips per day on average days and 60 trips per day on peak days (or up to 6 trips per hour during peak hours). Noise levels from a passing truck could result in individual noise peaks of approximately 80 dBA at 50 feet or 85 dBA at 25 feet from the roadway centerline (at 25 mph) and interior noise levels due to a passing truck at residences could reach 60 or 65 dBA with the windows closed and 70 or 75 dBA with the windows open. Where residences are setback 50 feet from the roadway centerline, such levels would not exceed the 70 to 80 dBA speech interference criteria (with windows closed). However, where residences are set back 25 feet from the roadway centerline, a passing truck could generate noise levels of 85 dBA, which could interfere with speech in rooms facing the street.

Transmission and Distribution Pipelines. Operation of heavy equipment associated with cut-and-cover construction would generate noise levels similar to those listed in Table 33 (p. 342). As part of pipeline construction, sheetpiles are sometimes needed to support the sides of the excavation. Sonic or vibratory sheetpile drivers, rather than impact drivers would be used for cut-and-cover construction. While these types of pile drivers minimize the pounding noise, they do cause a different type of noise and vibration that is annoying to some (see discussion on p. 354 below for vibration impacts). Residents living along cut-and-cover recycled water transmission/distribution lines would be subject to noise disruption due to the proximity of construction activities to these residences.

Assuming that cut-and-cover construction would progress at a rate of 50 to 200 feet per day, maximum noise levels directly in front of an individual residence would last for approximately one to two days. However, construction activities could occur in the vicinity of any one location along the construction route for one to two weeks. Under worst-case conditions, construction activities would be as close as approximately 10 to 25 feet from a residence (where construction occurs in the curb lane and the residence is setback 0 to 15 feet in accordance with the applicable zoning regulations). At this proximity, noise levels at the exterior of the residence could reach 86 to 92 dBA assuming feasible noise controls are implemented and vibratory sheetpile drivers are used as proposed (see Table 33, p. 342).

Noise peaks generated by construction equipment could result in temporary disturbance (e.g., speech interference) to persons in adjacent buildings as described above, under Construction

Equipment (p. 341), if the noise level in the interior of the building exceeds 45-60 dBA.[9] Interior noise levels of 66 to 72 dBA (with windows closed) could be reached, and such levels could periodically interfere with speech during the one to two days when construction occurs in front of any given residence. While most of the pipeline routes have not yet been determined, there are a few pipeline routes which are specifically proposed as part of the Master Plan. Sensitive receptors located along the specified pipeline routes include residential uses along Sloat Boulevard, 45th Avenue, and Santiago Street.

Truck traffic associated with hauling excavation spoils and equipment/material deliveries would be generated along transmission/distribution line routes. The extent of noise increase due to truck traffic would depend on the specific roads used by trucks, as well as existing truck volumes and the residential setbacks along those roads. Likely truck routes would include: (1) roads where pipelines would be located (see Figure 12, p. 40); (2) haul routes indicated in Figure 56 (p. 211); (3) the closest major streets (e.g., Great Highway, Sunset Boulevard); and (4) various residential streets in the Sunset and Richmond districts that provide access to pipeline alignments. In general, truck noise increases would be most noticeable on residential streets which currently carry low levels of truck traffic. Truck traffic on haul routes could reach 22 trips per day with up to 3 trips during the peak hour. Noise levels from a passing truck could result in individual noise peaks of approximately 80 dBA at 50 feet or 85 dBA at 25 feet from the roadway centerline (at 25 mph) and interior noise levels due to a passing truck at residences could reach 60 or 65 dBA with the windows closed and 70 or 75 dBA with the windows open. Where residences are set back 25 feet from the roadway centerline, a passing truck could generate noise levels of 85 dBA, which could interfere with speech in rooms facing the street.

Cumulative Construction Noise Impacts

The proposed Zoo Master Plan and the Zoo Infrastructure Master Plan both propose new facilities in the vicinity of the Fleishhacker RWTP site. Of the projects identified in the Zoo Infrastructure Master Plan, none would occur during construction of the RWTP. Projects identified in the proposed Zoo Master Plan that could occur during RWTP construction include the Zoo Entry Plaza/Parking project, African Savanna Exhibit Improvement project, and North American /Children's Zoo Exhibit Improvement project. The Entry/Parking project would be

[9] In indoor noise environments, the highest noise level that permits relaxed conversation with 100% intelligibility throughout the room is 45 dBA. Speech interference is considered to become intolerable when normal conversation is precluded at 3 feet, which occurs when background noise levels exceed 60 dBA. In outdoor environments, the highest noise level that permits normal conversation at 3 feet with 95% sentence intelligibility is 66 dBA (US Environmental Protection Agency, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety)*, March 1974.

located in the same area as the RWTP project, while the latter two projects are located immediately east (within 200 feet) of the RWTP site. If any of these projects were constructed at the same time as the RWTP project, temporary cumulative noise impacts could result. Until proposed improvements are more clearly defined, cumulative construction noise level increases cannot be quantified. However, simultaneous construction at these locations would result in more frequent noise peaks from equipment operation. Cumulative noise increases would not be anticipated except in areas located adjacent to both sites since noise generated by construction equipment at each site would primarily affect noise levels in the immediate vicinity of that site.

When considering the combined effect of constructing all of the above planned projects in the Zoo vicinity, the cumulative noise impact would relate to the generation of construction noise over an extended period of time. Such elevated construction-related noise levels would result in periodic disturbance of nearby residents and Zoo uses (including the animal collection). However, some of the animals appear to become habituated to construction noise over time (during construction of the Oceanside plant, there were fewer complaints by zoo keeper staff at the end of the project as compared to the beginning of the construction project).[10]

Construction-Related Vibration - General

Vibrations caused by construction activities can be interpreted as energy transmitted in waves through the soil mass. These energy waves generally dissipate with distance from the vibration source (i.e., the construction activity such as pile driving) due to spreading of the energy and frictional losses. The energy transmitted through the ground as vibration, if great enough, can result in structural damage. In order to assess the potential for structural damage associated with vibration, the vibratory ground motion in the vicinity of the affected structure is measured in terms of peak particle velocity (PPV) in the vertical and horizontal directions, typically in units of inches per second (in/sec).

Studies have indicated that the threshold for structural damage to residential buildings corresponds to a peak particle velocity of 2 in/sec in the ground adjacent to the affected structure.[11] The damage threshold for commercial structures has been reported to be 6 in/sec. Architectural damage can occur at 1.0 in/sec.[12] It should be noted that people can perceive much

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10 Environmental Science Associates, *Oceanside WPCP Construction Project, Environmental Compliance Summary Report, January 1989 - December 1994,* November 1994.

11 Orion Environmental Associates, *Final Environmental Impact Report: Richmond Transport Project,* 87.240E, June 28, 1990.

12 ibid.

lower particle velocity levels, about 0.1 in/sec, within several hundred feet of the vibration source.[13] Under the right circumstances, a vibration magnitude of 0.003 in/sec can be perceived by vibration-sensitive people.[14] Most people would not be annoyed by vibration levels of 0.0056 in/sec or less for short periods of time.[15] For comparison purposes, background vibrations from trucks or buses traveling on roadways have been measured at levels between 0.01 and 0.1 inches per second.[16]

While these guidelines indicate the general level of human and structure response to different levels of vibration, actual human and structure response to different vibration levels can be highly variable. Response is influenced by a number of factors including soil type, distance between source and receptor, duration, and number of perceived events. Vibration monitoring conducted in the Seacliff Neighborhood as part of cut-and-cover construction activities for the Richmond Transport construction project indicate that soil characteristics can result in highly variable vibration attenuation rates over a given distance. In some cases, vibration was found to be higher at more distant locations, though typically vibration decreases with distance.[17]

The City and County of San Francisco has no officially adopted regulations limiting ground vibration.[18] The purpose of applying a criteria or standard to construction-related vibration levels would be to address two issues: structural damage and human annoyance. Although the issue of differential building foundation settlement in sandy type soils is not well-documented with respect to a safe criterion, architectural or structural damage would not appear to be a concern if vibration levels remain below 1.0 in/sec. However, people can be annoyed by much lower levels of vibration, and this is reflected in annoyance-related criteria, which are generally well below 1.0 in/sec. Caltrans uses a vibration criterion of 0.1968 in/sec PPV in the vertical direction for its construction projects. A criterion of 0.10 in/sec was implemented in contract specifications for tunnel blasting for the Richmond Transport project. Monitoring data for the Richmond Transport project indicated that the level of annoyance was tolerable to most residents for vibration levels of less than 0.1 in/sec (i.e., when no complaints were received). Some

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13 ibid.
14 Wilson, Ihrig & Associates, *Weekly Progress Report for Vibration Monitoring for Richmond Transport ECM (8/9 to 8/11/94),* August 12, 1994.
15 Wilson, Ihrig & Associates, *Construction Vibration and Blast Monitoring Plan for Richmond Transport Environmental Compliance Monitoring*, February 15, 1994.
16 Orion Environmental Associates, *Final Environmental Impact Report: Richmond Transport Project,* 87.240E, June 28, 1990.
17 Wilson, Ihrig & Associates, *Weekly Progress Report for Vibration Monitoring for Richmond Transport ECM (includes measurements from 9/2 to 9/29 and 10/14/94),* October 18, 1994.
18 Wilson, Ihrig & Associates, *Construction Vibration and Blast Monitoring Plan for Richmond Transport Environmental Compliance Monitoring*, February 15, 1994.

complaints were received with vibration levels of 0.2 in/sec, but the number of complaints increased when vibration levels reached or exceeded 0.3 in/sec.

Construction equipment could generate vibration which would be noticeable by people in the project vicinity. The nature and extent of vibration would depend on a number of factors including: distance to the sensitive receptor, the type of equipment used (impact or vibratory tools), construction techniques implemented, type of activity, depth of construction, subsurface conditions, duration, and number of events. To assess the potential vibration impacts associated with the project, studies of similar projects were reviewed and results of these studies are discussed below.

Construction-Related Vibration Impacts at Specific Sites

Recycled Water Treatment Plant - Fleishhacker Pool Site. Shoring would be done by either driven or vibrated sheetpiles, or drilled or driven soldier piles. Vibration would be a potential concern if sheetpiles or soldier piles are driven or vibrated. As part of the construction of the Oceanside Water Pollution Control Plant (located south of the site), a vibration standard was set for protection of the zoo animals at 0.126 in/sec (or 102 dB re 10^{-6} in/sec with respect to one micro-inch per second for one hour of exposure). Vibration monitoring conducted in areas surrounding the Oceanside construction site during vibratory pile driving operations indicated that vibration generally ranged between 0.00079 to 0.0398 in/sec (or 58 and 92 dB) and never exceeded the vibration standard. No adverse effects on the zoo animals were reported by zoo staff.[19] Other construction activities (such as site grading activities or concrete placement) generate lower levels of vibration than vibratory pile driving. Since vibratory pile driving did not adversely affect zoo receptors and did not exceed the standard, vibration associated with the proposed construction activities would also not be expected to have any adverse effects. However, given the proximity of proposed construction to zoo receptors and highly variable vibration attenuation rates that can result from different soil characteristics, there would still be a potential for vibration impacts on zoo animals. With implementation of mitigation measures such as pre-drilling soldier piles, using vibratory pile drivers rather than impact drivers, using construction techniques that minimize vibration levels, and implementing a vibration monitoring program, the zoo animal collection is not expected to be adversely affected by vibration associated with construction (see Chapter VII, Mitigation Measure I-15).

[19] Environmental Science Associates, *Oceanside WPCP Construction Project, Environmental Compliance Summary Report, January 1989 - December 1994,* November 1994.

Reservoirs. At the Lincoln site, shoring could be done with sheetpiles, and sheetpiles would also be required for installation of piping. Shoring requirements for the McLaren Park site have not yet been determined. Vibration effects of vibratory sheetpile driving at the Lincoln site and McLaren site (if required) could be similar to those described under cut-and-cover construction below. While surveys for other construction projects in San Francisco indicate that vibration levels can be highly variable, they would not be expected to reach levels that have been known to cause structural or architectural damage (greater than 1.0 in/sec).

Transmission and Distribution Pipelines. Cut-and-cover construction would result in noticeable levels of vibration along the transmission/distribution line routes. Although most of the pipeline routes have not yet been determined, sensitive receptors along the specified routes are listed in the Transmission and Distribution Pipelines Noise Impact discussion (p. 352). Vibration monitoring data collected as part of the Richmond Transport project indicate that the primary sources of vibration from cut-and-cover construction are from pavement breaking, pile driving, and compaction of backfill. In addition, if unknown buried structures are encountered and demolition/removal of the structure is required, high levels of vibration can result. While vibration levels can vary widely due to soil conditions and distance between source and receptor, the following vibration levels were measured during cut-and-cover construction in the Seacliff Neighborhood and are presented in Table 35 below.

With vibratory sheetpile driving, the greatest vibration occurred when the pile was more than halfway driven and no excavation was done prior to driving. When excavation was done as sheetpile driving progressed, the vibration magnitude from this activity was less. While vibration levels can vary from one location to another due to subsurface conditions, measurements indicate that the degree of vibration is influenced by the construction techniques employed. Using these measurements as an indication of impact potential, annoying vibration levels (0.3 in/sec or higher) could occur during vibratory sheetpile driving (depending on the construction techniques employed) or if unknown buried structures are encountered and require removal. However, vibration levels would not be expected to reach levels that have been known to cause structural or architectural damage (greater than 1.0 in/sec). Mitigation measures included as part of the project require contractors to use construction techniques that minimize vibration levels (see Chapter VII, Mitigation Measures I-9, I-10, I-11, and I-12).

TABLE 35: SUMMARY OF VIBRATION MEASUREMENTS

Activity	Maximum Measured Vibration Inches per Second, Peak Particle Velocity (Vector Sum)
Moving CAT (Vibrator)	0.059 @ 42 ft.
Moving CAT (Backhoe)	0.043 @ 30-40 ft.
Pavement Breaking	0.056 -0.190 @ 30-50 ft.
Vibratory Sheetpile Driving	
Without Excavation (<1/2 sheet exposed)	0.253 - 0.383 @ 30 ft.
Without Excavation (>1/2 sheet exposed)	0.148 - 0.175 @ 30 ft.
With Excavation	0.204 - 0.209 @ 35 ft.
Sheetpile Driving by Excavator Shovel	0.055 - 0.217 @ 30-50 ft.
Vibratory Soil Compaction	0.031 - 0.199 @ 38-170 ft.
Earth Excavation	0.056 @ 42 ft.
Removal of Sheetpiles	0.04 - 0.071 @ 25-45 ft.
Removal of Metal Plates	0.028 - 0.178 @ 25-45 ft.
Removal of Soldier Piles	0.1 - 0.178 @ 30-45 ft.
Removal of Unknown Structures (Buried Junction Box)	> 0.311 @ 30-50 ft.

NOTE: Vibration levels are presented here as peak particle velocity in both the vertical and horizontal directions (vector sum). Vibration levels are presented for informational purposes only.

SOURCE: Wilson, Ihrig & Associates, 1994. *Weekly Progress Reports for the Vibration Monitoring for Richmond Transport ECM.* August 12, August 31, September 19, September 27, and October 18.

Operational Noise

Operation of the proposed recycled water system pumps would result in long-term noise increases. Pumps would be located within the RWTP and pump station at the RWTP site as well as within the pump station proposed at the Lincoln High School Reservoir. The degree of impact would vary with each project component, and would depend on pump sizes and proximity to sensitive receptors.

Recycled Water Treatment Plant - Fleishhacker Pool Site

The primary source of operational noise associated with the proposed treatment facility would be the pumps. The level of noise generated by pumps and other stationary equipment depends on four major variables: characteristics of the noise source (e.g., technology type, rated horsepower,

revolutions per minute [rpm], presence or absence of pure tones, directional characteristics of the noise source, presence or absence of acoustical design features); (2) number of noise sources clustered together; (3) type and effectiveness of the building enclosure; and (4) operational characteristics (steady 24-hour operation, intermittent operation, variable settings at different times, etc.).

Pumps at the proposed treatment facility and pump station would have motors ranging from 25 to 500 horsepower (Hp), with 6 of the 13 pumps having 500 Hp motors. Other pump characteristics such as rpms, presence or absence of pure tones, and directional characteristics of the noise source have not been specified. In addition, the type of building enclosure and noise attenuation effectiveness of the enclosure have also not been determined. Noise measurements taken at other facilities are listed in Table 36. Noise measurement data also indicate that the spectral character of pump noise can vary with the pump type, with vertical turbine pumps generating noise levels on the upper range of the noise spectrum. Continuous, high frequency noise from pump operation could contrast with the existing noise environment, which is characterized by lower frequency ambient noise associated with auto traffic and other noise sources. This contrast in the spectral character of the noise sources can increase the potential for annoyance at nearby sensitive receptors.

The proposed treatment facility would have six, propeller/mixed flow pumps with 20 Hp motors. The pump station at the treatment facility site would have six vertical turbine pumps with 500 Hp motors, three horizontal centrifugal pumps with 350 Hp motors, two vertical turbine pumps with 60 Hp motors, and two vertical turbine pumps with 25 Hp. The data in Table 36 suggest a pump noise reference level of 68 dBA at 50 feet for a 100 Hp pump. The level for one 500 Hp pump is estimated to be 75 dBA at 50 feet, and for a 350 Hp pump, 73 dBA at 50 feet.[20] If all the operating pumps in the tertiary treatment plant were operating together in one area, their estimated combined noise level is estimated to be 84 dBA at 50 feet. Since pumps would be enclosed, the exterior noise level would be much lower. Louvered enclosures that block noise but allow for air circulation reduce noise by 15 to 20 dBA. Solid masonry walls with no physical

[20] Measurement data for pump noise in Table 37 was for smaller pumps than the proposed 500 Hp units. However, pump measurement data in technical literature (J.D. Irwin, *Industrial Noise & Vibration Control,* 1979) indicate that there is a direct correlation between average pump noise (Leq) and horsepower and it is expressed as follows: Leq = 10 log Hp + Kp, where log is the base-10 logarithm, Hp is the pump horsepower, and Kp is a universal pump constant. The noise level for any other horsepower pump can be expressed as follows:

$$(Leq)_2 - (Leq)_1 = 10 \log \frac{(Hp)_2}{(Hp)_1}$$

TABLE 36: NOISE LEVELS GENERATED BY PUMPS

Pump Specifications/Characteristics	Number of Pumps	Noise Level	Reference at 50 Feet
Marin Municipal Water District, Ignacio Pump Station/a/			
150 Hp, 1,800 rpm	2	78 dBA at 32 feet	74 dBA
Vallejo Wastewater Treatment Plant/b/			
100 Hp, 1,800 rpm	2	69 dBA at 50 feet	69 dBA
50 Hp, 3,600 rpm	1	63 dBA at 50 feet	63 dBA
Mesa Consolidated Water District, South Coast Pump Station/c/			
100 Hp, 2,100 rpm	1	66 dBA at 80 feet	70 dBA
Mesa Consolidated Water District, Sunflower Pump Station/c/			
100 Hp, 2,100 rpm	1	63 dBA @ 104 feet	69 dBA
Irvine Ranch Water District/d/			
125 Hp, 2,000 rpm	1	75 dBA @ 30 feet	71 dBA
General Category (US EPA)/e/	1	76 dBA at 50 feet	76 dBA

/a/ Source: Noise monitoring by ESA in August, 1994.
/b/ Source: Noise monitoring by ESA in July, 1994.
/c/ Source: Noise monitoring by Giroux & Associates in March 1995. Noise measurement includes partial reflection from surrounding masonry wall.
/d/ Source: Noise monitoring by Giroux & Associates in March 1995. Noise measurement includes blower noise from air stripper attached to pump discharge for VOC removal.
/e/ Source: US Environmental Protection Agency, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, December 1971.

opening to the pump enclosure can reduce noise levels by 40 dBA. The location of the vent opening is therefore important in determining the noise propagation direction. In vented directions, the noise level at 50 feet would range from 64 to 69 dBA. In the solidly-shielded directions, pump noise levels would be 20 dBA lower and not audible above ambient (non-pump) noise levels.

While pumps in wastewater treatment processes are often enclosed, air blowers may sometimes be less shielded. Aeration blower noise also depends upon fan horsepower similar to liquid

pump noise. Blowers also often have more of a high-pitched "whine" which can be offensive to receptors near the source. Blowers would be used in the UV lamp bank cleaning tank, for filter media backwash, and as part of the acid fume scrubber. Noise measurements taken at another wastewater facility indicate that aeration blowers and scrubber fans can generate noise levels of 67 to 75 dBA at 50 to 75 feet.[21] When compared to noise levels generated by enclosed pump stations, blower-related noise could be a more noticeable contribution to overall project noise characteristics.

Emergency generators are also proposed at the treatment facility. While the size and type of generators and design of building enclosure has not been specified, noise measurements taken at other emergency generators indicate that exterior noise levels of 85 dBA at 50 feet could be generated without any acoustical enclosure. With a surrounding masonry barrier, or with generator placement using other structures as shielding, the effective noise level may be reduced to 70 to 75 dBA at 50 feet. Since the emergency generator would operate infrequently (only for testing periodically and during power outages), it would not contribute substantially to the overall average noise exposure outside the project property boundary.

Future residential uses and zoo-related uses within 120 to 150 feet of the proposed treatment facility could be subject to noise levels up to 76 dBA if noise sources were not enclosed. However, pumps, blowers, fans, and emergency generators would be constructed within enclosures. The effectiveness of enclosures is highly variable, with noise measurements indicating that acoustically-treated buildings could provide up to 15 to 40 dBA[22] reductions in noise. Assuming acoustically-treated enclosures are provided on all potential noise sources (as specified in Chapter VII, Mitigation Measure I-14), project-related noise sources would generate noise levels between 36 and 61 dBA at the nearest sensitive receptors. Operation of the emergency generator could intermittently raise noise levels to 63 to 64 dBA at the nearest noise-sensitive use. Such noise levels would be within the range of ambient daytime and nighttime noise levels that were measured at the Oceanside Water Pollution Control Plant; therefore, noise increases associated with project operation would not be expected to generate noticeable noise increases in the site vicinity.

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21 Noise measurements taken by Environmental Science Associates on June 15, 1994 at the Roseville wastewater treatment plant.

22 Based on noise measurements taken at other wastewater treatment facilities by Environmental Science Associates and Giroux & Associates.

Reservoirs and Transmission/Distribution Pipelines

There would be no sources of noise associated with project pipelines or reservoirs, which are proposed to be underground. The only locations where noise could be emitted from these facilities would be at surface vents. However, there would be no sources of operational noise since there would be no pumps or other noise-generating equipment associated with reservoirs or pipelines. Pumps would only be located at pump stations at the RWTP site (discussed above) and Lincoln High School Reservoir site (discussed below).

Lincoln Reservoir Pump Station. The primary source of operational noise associated with the proposed pump station would be the pumps. This pump station would have four vertical turbine pumps with a motor size of 200 Hp. Noise measurements taken at enclosed pumps similar in size and design to the proposed pumps indicate that exterior (outside the pump enclosures) noise levels of 65 dBA at 100 feet could be generated at the site by a 200 Hp motor on a vertical turbine pump.[23] The combined effect of the four pumps operating could increase these noise levels by 6 dBA. Since pumps would be located underground and they would be enclosed, noise levels could be reduced to 35 to 50 dBA at 100 feet depending the effectiveness of acoustical treatments at vent openings to the pump station. With adequate acoustical treatment of the pump ventilation system (as specified in Chapter VII, Mitigation Measure I-14), pump noise could be maintained at levels that would not exceed ambient noise levels.

[23] J.D. Irwin, *Industrial Noise & Vibration Control,* 1979 using formulas as presented in Footnote 20 above.

A.10 BIOLOGICAL RESOURCES

This section is organized by the two RWMP activities that could affect biological resources: landscape irrigation with recycled water and facility construction. The analysis of landscape irrigation addresses generally the types of plants and landscaped areas that would be irrigated with recycled water throughout the city. The analysis focuses on recycled water quality and the effects and sensitivities different plant types might have. The discussion does not address issues for specific sites proposed for landscape irrigation. The potential effects of facility construction on biological resources are site-specific and are therefore evaluated for each site at which construction would occur.

Landscape Irrigation

Landscape irrigation would be the major use of recycled water under the proposed RWMP. In general, the quality of the proposed recycled water is anticipated to be suitable for landscape irrigation in a range of site conditions in the City, and it would not be expected to adversely affect landscape vegetation, as discussed below.

The effects of irrigation with recycled water on landscape plants depends on several factors, including: water quality of the recycled water, sensitivity of the plant materials to the salts and other chemicals contained in the water; soil texture and drainage characteristics; chemical characteristics of the soils; method of irrigation, whether sprinkler or drip; and irrigation management practices.

Water quality concerns for landscape irrigation focus on the presence and concentration of total salt (measured as total dissolved solids or electrical conductivity) as well as the presence of several specific ions, including chloride, sodium, boron, bicarbonate, pH, trace elements and nutrients (nitrogen, phosphorus and potassium). Excessive amounts of these substances in irrigation waters could result in adverse effect to plants or soils.[1] Table 37 summarizes in general the constituents present in recycled water that can affect landscape plants and soils depending on their construction and method of application.

Table 38 summarizes general water quality criteria for irrigation use that have largely been developed based on agricultural rather than landscape plants. The guidelines indicate potential

[1] HortScience, Inc., *Use of Recycled Water for Landscape Irrigation*, prepared for the City and County of San Francisco under subcontract to Environmental Science Associates, 1992.

TABLE 37: POTENTIAL EFFECTS OF RECYCLED WATER ON LANDSCAPE PLANTS AND SOILS

Constituent	Measured Parameter	Reason for Concern
Dissolved inorganics	Total dissolved solids (TDS); electrical conductivity (EC); specific elements (e.g., sodium, calcium, magnesium, chloride, boron)	Excessive salinity may damage some plants. Specific ions such as chloride, sodium, boron are toxic to some plants. Sodium may pose soil permeability problems.
Hydrogen ion activity	pH	The pH of water affects metal solubility as well as alkalinity of soils.
Heavy metals	Specific elements (e.g., cadmium, zinc, nickel, mercury)	Some heavy metals accumulate in the environment and are toxic to plants.
Nutrients	Nitrogen, phosphorus, potassium	Nitrogen, phosphorus and potassium are essential nutrients for plant growth, and their presence normally enhances the value of the water for irrigation. When discharged to the aquatic environment, nitrogen and phosphorus can lead to the growth of excess algae. When discharged in excess amounts on land, nitrate can lead to groundwater pollution.
Residual chlorine	Free and combined chlorine	Excessive amount of free chlorine may cause leaf-tip burn and damage sensitive plants. However, most chlorine in recycled water is in a combined form, which does not cause damage.
Suspended solids	Suspended solids	Excessive amounts of suspended solids cause plugging in irrigation systems.

SOURCE: Pettygrove and Asano, 1985 from HortScience, *Use of Recycled Water for Landscape Irrigation in San Francisco Parks*, prepared for Environmental Science Associates, December 1992.

TABLE 38: SUITABILITY OF RECYCLED WATER QUALITY FOR IRRIGATION

Constituent	Units	Use Classification			Estimated Recycled Water Concentration	
		Acceptable	Marginal	Unacceptable		
Salinity						
Electricity Conductivity	ds/m	<0.7	0.7 - 3.0	>3.0	0.69	Acceptable
Total Dissolved Solids	mg/l	<450	450 - 2,000	>2,000	394	Acceptable
Permeability						
Sodium	percent [a]	<60	60 - 75	>75	69	Marginal
SAR	-	<6	6 - 9	>9	5.2	Acceptable
Specific Ion Toxicity						
Aluminum	mg/l	<5.0	>5.0	-	<0.20	Acceptable
Boron	mg/l	<0.5	0.5 - 1.0	>1.0	0.49	Acceptable
Cadmium	mg/l	<0.005	>0.005	-	<0.0020	Acceptable
Chloride						
Surface Irrigation	mg/l	<140	140 - 350	>350	146	Slightly Marginal
Sprinkler Irrigation	mg/l	<100	>100	-	146	Slightly Marginal
Copper	mg/l	<0.2	>0.2	-	0.0104	Acceptable
Iron	mg/l	<5.0	>5.0	-	0.13	Acceptable
Manganese	mg/l	<0.2	>0.2	-	0.03	Acceptable
Nickel	mg/l	<0.5	>0.5	-	<0.020	Acceptable
Sodium						
Surface Irrigation	SAR	<3	3 - 9	>9	5.2	Marginal
Sprinkler Irrigation	mg/l	<70	>70	-	110	Marginal
Sulfate	mg/l as SO4	<950	950 - 1,900	>1,900	39	Acceptable
Zinc	mg/l	<5.0	>5.0	-	0.037	Acceptable
Miscellaneous Effects						
Total Nitrogen	mg/l as N	<5	5 - 30	>30	27	Marginal
Residual Sodium Carbonate	meq/l	<1.25	1.25 - 2.5	>2.5	2.1	Marginal
Bicarbonate	mg/l as HCO3-	<90	90 - 520	>520	237	Marginal
pH	-	6.5 - 8.4	-	-	7.1	Acceptable
Residual Chlorine	mg/l	<1.0	1.0 - 5.0	>5.0	<1.0	Acceptable

NA - Not analyzed

NOTES: mg/l = milligrams per liter; ds/m = deci sieman per meter; SAR = Sodium Adsorption Ratio; meq/l = milliequivalents per liter.

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan, Draft*, July 1996.

restrictions on the use of water for irrigation, based upon the quality of the water, although other factors such as individual sensitivities of various plants, contribute to the actual suitability of the water for irrigation. In addition, suitability of water for landscape irrigation may have somewhat varying criteria compared to agricultural irrigation. Irrigation water is classified as "acceptable," "marginal," or "unacceptable" based on concentrations of various constituents. Comparison between the projected quality of the disinfected tertiary treated recycled water, also shown in Table 38, and the guidelines indicates that the recycled water would be of acceptable quality for irrigation use for most parameters, as discussed below. Both SFWD water and groundwater are currently used for landscape irrigation in the City, indicating varying water quality among existing irrigation sites. The recycled water would represent an additional irrigation water source which would increase the variation of water quality used at various irrigation sites.

If recycled water of the proposed quality shown in Table 38 were used for landscape irrigation, there would be no use restrictions based on overall salt levels, shown as total dissolved solids or specific conductance, nor would there be restrictions associated with trace elements (including aluminum, cadmium, copper, iron, manganese, nickel and zinc) or permeability (shown as sodium adsorption ratio). The estimated recycled water quality is "slightly marginal" for sodium and chloride; projected levels of sodium and chloride in the recycled water could pose slight to moderate restrictions for irrigation use, depending on the specific vegetation to which it is applied. High levels of sodium could affect soil permeability, although the predicted sodium adsorption ratio in the recycled water, which is a more accurate indicator of soil permeability than sodium levels alone, indicates there would be no use restrictions. The projected chloride level in the recycled water could result in chloride toxicity or leaf damage to some plants, particularly if applied by spray irrigation. The Bureau of Water Pollution Control is currently investigating the major sources of the sewerage system's sodium chloride, elimination or reduction of which could reduce sodium and chloride concentrations in the recycled water to within the "acceptable" range.

The estimated recycled water quality is also "marginal" for total nitrogen, residual sodium carbonate (RSC), and bicarbonate. Total nitrogen is a measure of a key nutrient for plant growth. However, total nitrogen is more beneficial in earlier rather than later stages of plant growth. Excessive nitrogen can cause detrimental effects, such as excessive vegetative growth and delayed maturity. The RSC concentration is used to indicate potential soil permeability problems from dissolved carbonate.

Boron, which is toxic to many plants at low concentrations, is not expected to be a problem in the recycled water based on the current levels in the Oceanside WPCP effluent.

In order to assess more specific effects of recycled water on landscape irrigation, the Department of Public Works conducted a pilot study at Golden Gate Park from July 1993 to May 1995. The pilot study examined about 30 species of plants in containers in the nursery and compared the effects of irrigation with recycled water to those of irrigation with SFWD water. The study also compared two adjacent vegetated plots in the Park, one of which was watered with recycled water, and the other of which was watered with groundwater. Periodic chemical testing of the various waters, plant tissues, and soil was conducted and regular plant observations were made. The results of the study indicated that no negative effects of recycled water were either measured or observed on plant tissues or soils with recycled water. Salt concentrations were within safe ranges for plants and soils, and there were no discernible differences between plants irrigated with recycled water and those irrigated with SFWD water or groundwater. Overall, for both water types, plant appearance and plant growth were healthy and vigorous. [2]

The Golden Gate Park Draft Master Plan prepared in March 1995 states that one of its primary design criteria for the Park's water supply system is "flexibility to utilize well water and/or reclaimed water as a supply source."[3] The Golden Gate Park Draft Master Plan also includes a map showing Park vegetation areas which are suspected to be sensitive to reclaimed water.

A survey of parks in San Francisco was conducted to identify a range of plant materials and soil types. Over 70 species of plants were identified, although the bulk of vegetation in all parks was represented by relatively few species, as shown in Table 39. This table also includes plants representative of most of Golden Gate Park, with the exception of the specialty garden areas. Table 39 also presents relative salt tolerances of the major plant species and indicates suitability for irrigation with recycled water based on the projected water quality. The table indicates there would virtually be no anticipated effect on any of the plant species listed if irrigated with recycled water. The only possible exception would be redwood trees, which may be subject to chloride toxicity over the long term, although data collected on redwoods as part of the Landscape Irrigation Pilot Study indicated no differences between plants irrigated with recycled water and plants irrigated with the control water.

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2 Hsiao, Joyce; Matheny, Nelda; and Moulton, Leslie, 1996. *Landscape Irrigation Pilot Study with Recycled Water at Golden Gate Park, Final Report.* Technical Memorandum to Karen Kubick, San Francisco Department of Public Works.

3 San Francisco Recreation and Park Department, *Golden Gate Park Draft Master Plan*, March 1995.

TABLE 39: POTENTIAL EFFECTS ON PLANTS COMMON IN CITY PARKS FROM IRRIGATION WITH RECYCLED WATER

Major Vegetation in San Francisco Parks	Relative Salt Tolerance /a/	Potential Effect of Irrigation with Recycled Water /b/
Turf/meadow	High	None
Acacia	Moderate	None
Parney cotoneaster	High	None
Monterey cypress	Moderate	None
Eucalyptus	High	None
Sweet hakea	Moderate	None
Ivy	Moderate to High	None
Australian tea tree	Low	None
Glossy privet (Japanese privet)	High	None
Myoporum	High	None
Olive	High	None
Monterey pine	High	None
Pittosporum	Moderate	None
Firethorn (Pyracantha)	Moderate	None
Coast live oak	Moderate	None
Redwood	Low	Possible chloride toxicity
Bush cherry	Moderate	None

/a/ Plant species and salt tolerances from HortScience, Use of Recycled Water for Landscape Irrigation in San Francisco Parks. December 1992.
/b/ Due to low total dissolved solids (<500 mg/L) in recycled water, no effects would be expected based on salt tolerances. However, there are limited data on specific ion toxicity for these species.

SOURCE: HortScience, 1995.

In addition to sensitivity of various plants to the salt content of recycled water, the type of soil can also affect the suitability of using recycled water for landscape irrigation. Sodium in irrigation water can accumulate in soils and reduce soil permeability. Clay soils are more susceptible than sandy soils to sodium problems and could be problematic if there are high sodium levels in the recycled water. The water quality data indicate that the sodium level (in water used for sprinkler irrigation) would be about 110 mg/L, which is about one third of the level measured in the existing groundwater used for sprinkler irrigation in Golden Gate Park

(307 mg/l) (see Table 25, p. 263, in Groundwater and Surface Water Resources, for groundwater quality data). Although there is the long-term potential for salts, including sodium, to accumulate in soils and to reduce soil permeability, the seasonal weather pattern in San Francisco would likely result in leaching of the salts during the rainy season. This would reduce any potential for long-term build-up of salts in the soils. Impacts on groundwater of irrigation with recycled water are discussed in Section V.A.2, Groundwater and Surface Water Resources, p. 261.

Use of recycled water for landscape irrigation would have the beneficial impact of providing additional nutrients to the plants. Recycled water generally contains higher levels of nitrogen, phosphorus and potassium than potable water. Nitrate measured in the Oceanside WPCP secondary effluent in 1995 indicated a level of 62 mg/L, which is higher than recent levels measured in groundwater (10.4 mg/L, 1993) and City water (0.46 mg/L, 1994), as shown previously in Table 25, p. 263, in Groundwater and Surface Water Resources. Nitrogen as nitrate is the form most readily available to plants, and its presence in recycled water used for irrigation would enhance plant growth, since nitrogen is regularly applied to lawns and landscaped areas in the form of fertilizer. Use of recycled water would potentially reduce the fertilization required at the landscape irrigation sites, and at the same time, reduced application of fertilizers could reduce possible nitrate infiltration to the shallow groundwater. See Section V.A.2, Groundwater and Surface Water Resources Impacts, p. 261, regarding potential effects of landscape irrigation with recycled water on groundwater quality.

Landscape irrigation with recycled water would also have the potential to result in ponding or accumulation of surface runoff. In areas adjacent to surface water bodies, such as ponds or lakes in the City parks, there is the potential that nutrients present in the recycled water could promote excess algae growth or eutrophication. However, water reuse requirements issued by the Regional Water Quality Control Board would restrict application of recycled water to prevent saturated conditions in proximity to a water body. Compliance with these requirements would minimize or eliminate any potential impact on lakes or ponds. Refer to Section V.A.2, Groundwater and Surface Water Resources Impacts section, p. 261, for further discussion.

Addition of recycled water to the irrigation system would increase the reliability of the City's water supply, particularly during drought periods. During drought periods, water available for landscape irrigation can be substantially reduced as potable water is re-directed to meet demands for drinking and other essential water uses. Provision of an alternative water source for

irrigation could therefore reduce, though not eliminate, the effect of drought on the City's landscaping.

RWMP Facilities Construction

Recycled Water Treatment Plant (RWTP) - Fleishhacker Pool Site

The currently proposed facility layout would restrict the RWTP construction almost entirely within the Bath House footprint and the paved area of the former Fleishhacker Pool. As is shown on Figure 13 (p. 42), a layout of the site, construction of the access road around the perimeter of the RWTP would cut into the southern end of the existing berm adjacent to the Westside Pump Station. The existing vegetation on the berm is mainly planted or naturalized non-native species, though some native species may be found on-site, as discussed in Section IV.J, Biological Resources (p. 236). This vegetated berm can be seen on Figure 36, (p. 118), an aerial of the site. Removal of a small portion of the berm would result in a minor loss of vegetation.

Construction of the RWTP would temporarily disturb any animal use in the area. As described in the setting section (p. 237), animals expected to occur onsite include birds, small mammals and rodents. Construction disturbance would prompt many of these animals to avoid the construction area and use other areas of the Zoo grounds and vicinity until construction is completed. Animal use would return to the site following RWTP completion.

Following RWTP construction, a new berm would be extended along the western edge of the site south to the proposed new Zoo entrance on the Great Highway. It is recommended by the California Native Plant Society that this new berm (and the existing berm and pump station area, if necessary) be revegetated with native California dune plants such as prostrate coyote brush (*Baccharis pilularis*) and other species of the Franciscan Coastal Scrub and appropriate dune species raised from local seed sources, rather than with non-native weedy species.[4] This would be consistent with revegetation efforts at the Oceanside WPCP. This new berm would provide additional vegetation and animal use area on site.

[4] Susan Smith, California Native Plant Society, Rare Plant Committee, telephone communication with Amy Armstrong, Environmental Science Associates, March 6, 1995.

Construction of a west access point to the site would necessitate the removal of 5 to 10 mature trees and other planted vegetation currently growing in the area between the Great Highway and the Fleishhacker Pool site vicinity.

Noise and dust associated with construction activity could potentially disturb animals in the adjacent San Francisco Zoological Gardens. Potential air quality and noise impacts due to RWTP construction are discussed in Sections V.A.8 (p. 325) and V.A.9 (p. 340), respectively. Sensitive Zoo animals would be monitored during peak construction periods; if substantial disturbance of animals due to construction is observed, then animals would be relocated or protected from further disturbance, as described in Section VII, Mitigation Measure I-15.

Lincoln High School - Reservoir Site and McCoppin Square Park - Construction Staging Area

Construction of a 15-million-gallon reservoir on the Lincoln High School site and use of McCoppin Park as a staging area would cause the short-term loss of approximately 2.8 acres of turf grass in the Lincoln High School football field. Up to ten Monterey pine, Monterey cypress and acacia trees might need to be removed between Santiago Road and the football stadium perimeter wall, in order to allow construction staging and access. The 13 mature trees within the planned staging area at the northern end of McCoppin Square Park (shown in Figure 15, [p. 51], the site layout, and on Figure 41, [p. 131] an aerial of the site) would not be removed, but could be subject to root and trunk damage from operation of heavy equipment or storage of materials in proximity to tree trunks or over their root systems (where soil compaction could impair roots).

Mature trees within the staging area would be protected with fencing during construction (see Section VII, Mitigation Measures J-6 and J-8, for mitigation measures regarding protection of resources during construction and restoration of the site). Trees would be replanted in the area of removal, turf would be replaced, and any impacted portion of McCoppin Square Park vegetation would be restored or replaced after construction is complete. With these mitigations, no substantial loss of biological resources would occur. Given the amount of human disturbance presently occurring around these trees and the wind exposure, it is unlikely that these trees serve as roosting sites for Monarch butterflies; no impacts to butterflies are expected. However, in the event that Monarch butterflies occur at this site in the future, a mitigation measure regarding potential impacts has been included in the project as a precaution (see Chapter VII, Mitigation Measure J-7).

Construction activity would cause temporary disturbance of animal use in the area (primarily birds, small mammals and rodents). Following construction completion and restoration of the vegetated areas, no long term loss of habitat or ongoing wildlife disturbance would occur.

McLaren Park - Reservoir Site

Site 1. Construction of a 15-million-gallon reservoir on this site would cause the permanent loss of approximately 1.5 acres of non-native grassland, and the removal of approximately 15 Monterey cypress and pine trees (see Figure 17 for a reservoir layout that indicates tree locations, and Figure 43, p. 135, which is an aerial photograph of the site area).

Wildlife use of the site and vicinity would be disrupted during the 12-month construction period. This temporary disturbance would not result in wildlife population reductions nor changes in species diversity. Wildlife use would return following reservoir completion.

Site 2. Construction of the divided reservoir at McLaren Park Site 2 would result in the temporary loss of approximately 4 acres of grassland. Following completion of the buried reservoir the grassland would be restored.

There are an estimated 23 mature trees, a mix of Monterey pine and cypress and eucalyptus, that occur within the proposed reservoir footprint or close enough that it is expected they would be removed or damaged in the construction process. It is expected that reservoir construction would not require removal of any of the trees within the densely wooded areas to the north and northwest of the reservoir site. There appears to be adequate distance between the site and these wooded areas (25 to 80 feet) that, with appropriate construction activity controls as proposed in the mitigation section (Chapter VII, Mitigation Measure J-6), these trees should be preserved.

Given the amount of human disturbance presently occurring around these trees and the wind exposure, it is unlikely that these trees serve as roosting sites for Monarch butterflies; no impacts to butterflies are expected. However, in the event that Monarch butterflies occur at this site in the future, a mitigation measure regarding potential impacts has been included in the project as a precaution (see Chapter VII, Mitigation Measure J-7).

Given the amount of human disturbance presently occurring around these trees and the wind exposure, it is unlikely that these trees serve as roosting sites for Monarch butterflies; no impacts to butterflies are expected. However, in the event that Monarch butterflies occur at this site in

the future, a mitigation measure regarding potential impacts has been included in the project as a precaution (see Chapter VII, Mitigation Measure J-7).

The reservoir would be located upslope of a natural topographic drainage area which supports a dense woodland and willow thicket area. Construction of the buried reservoir would alter the topography of the hill. Drainage patterns would be modified but surface runoff from the site would continue to drain into the draw. Surface drainage modifications are not expected to result in adverse impacts to downslope vegetation within the drainage area.

There is also a reported spring within the densely vegetated area approximately 30 feet northeast and 40 to 500 feet down slope from the reservoir site. The spring was not observed during field survey in 1993 and 1994 but the dense vegetation obscures the area. Reservoir construction would not directly affect this area. Indirectly, installation of the reservoir 30 feet below ground could modify subsurface drainage flows but groundwater would continue to flow downslope as it does presently. Given the distance between the reservoir and the reported spring location, the project would not be expected to adversely affect such downslope springs.

Wildlife use of the site and vicinity would be disrupted during the 12-month construction period. This temporary disturbance would not result in wildlife population reductions nor changes in species diversity. Wildlife use would return following reservoir completion.

A connection pipeline from the reservoir site to the pipeline in John F. Shelley Drive west of the site would be located in a 1,200-foot-long corridor of grassy area within the park. Construction of the pipeline by the open cut method would result in temporary disturbance of a maximum 6-foot-wide corridor. The area disturbed during construction of the pipeline would be re-landscaped after completion of construction in accordance with appropriate species and landscape design as specified by the San Francisco Recreation and Park Department.

Transmission and Distribution Pipelines

Installation of transmission and distribution pipelines would not affect biological resources; pipelines would be placed within City streets.

A.11 CULTURAL RESOURCES

Introduction

The following impact analysis is organized by project site because impacts associated with cultural resources are site-specific and would occur on a project-level basis only. No program-level impacts on cultural resources would result from implementation of the RWMP and overall operation of the recycled water system. All development projects that are specified in the RWMP are analyzed on a project-level basis. Undefined aspects of the RWMP are evaluated on a program-level and the only undefined aspects of the RWMP, as they relate to cultural resources, are the final locations of some of the pipeline alignments. Where pipeline alignments are specified, they are evaluated on a project-level basis. For cultural resources, the program-level impacts associated with undefined pipeline alignments (identified as corridors) are the same as the project-level impacts, i.e., the potential for buried resources would be similar because all defined and undefined pipelines would be located in existing city streets where surface disturbance and pavement coverage has already occurred.

Fleishhacker Pool Site

The proposed Recycled Water Treatment Plant (RWTP) would be located at the Fleishhacker Pool site. The old Bath House structure would be demolished, and the treatment facilities would be constructed in its place. The Department of Public Works would design the above-ground portions of the treatment plant to have approximately the same dimensions and location as the former Fleishhacker Bath House. Architectural treatment of the RWTP building would be determined during final design and would be determined in conjunction with the Recreation and Park Department.

As discussed in Section IV.K, Cultural Resources (pp. 243 to 250), the demolition of Fleishhacker Pool Bath House was discussed in the West Side Transport/Storage Project EIR.[1] The EIR concluded that no significant environmental impacts would result from the project; the conclusions of that report remain valid and no further CEQA review of these two components is required.[2]

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1 Environmental Impact Planning Corporation, *West Side Transport/Storage Project Final EIR,* No. EE75.304, prepared for the San Francisco Department of City Planning, certified July 28, 1977.

2 Paul Maltzer, Office of Environmental Review, City and County of San Francisco Department of City Planning, letter to Deborah Learner, Recreation and Park Department, October 14, 1992.

Construction of subsurface portions of project facilities would require excavation at the Fleishhacker Pool site. Although there are no recorded cultural resource sites at this location and a surface reconnaissance of the site did not reveal any resources, the potential for encountering subsurface resources during such excavation activities would still exist.[3] To minimize potential damage to artifacts, Mitigation Measure K-2 (Chapter VII) outlines procedures that the contractor must follow in the event any resources are encountered.

Reservoirs

The proposed project would involve excavation and subsurface construction for reservoirs at the Lincoln High School and McLaren Park sites. As described in Section IV.K, Cultural Resources (p. 243), no recorded subsurface cultural resources of prehistoric/protohistoric age are known to exist within the Lincoln High School and McLaren Park reservoir sites, but unrecorded archaeological sites from this era may exist.[4] The presence of prehistoric deposits discovered in San Francisco during recent archaeological work suggests that other, unrecorded similar archaeological deposits may exist in various places throughout San Francisco. There is no evidence that historical resources occur within or adjacent to the reservoir sites.[5] However, there would be a potential for unrecorded buried archaeological or historical resources to be encountered during construction of all RWMP facilities. To minimize potential damage, Mitigation Measure K-2 (Chapter VII) outlines procedures that must be followed in the event any resources are encountered.

Transmission and Distribution Pipelines

Pipeline development would involve shallow excavation of trenches that are proposed to be located in city streets. Pipelines would be located in areas that have undergone surface disturbance and pavement coverage due to street development. Although surface disturbance has already occurred, the potential for unrecorded buried archaeological or historic resources would still exist. In addition, buried maritime ship remains may be encountered if any pipelines are developed in the Ocean Beach area.[6] To minimize potential damage, Mitigation Measure K-2 (Chapter VII) outlines procedures that must be followed in the event any resources are encountered.

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3 Archeo-Tec, *Supplemental Cultural Resources Evaluation and On-Site Archaeological Survey of the San Francisco Water Recycling Master Plan Project Area*, prepared for Environmental Science Associates, November 19, 1992.

4 Archeo-Tec, *In-house Archival Cultural Resource Overview Study of Selected Sites Associated with the San Francisco Recycled Water and Groundwater Master Plan EIRs*, letter report to Environmental Science Associates, April 7, 1995.

5 ibid.

6 Archeo-Tec, *San Francisco Draft Water Recycling Master Plan Cultural Resources Evaluation 92.371E*, prepared for the San Francisco Department of Public Works, January 13, 1993.

A.12 ENERGY AND NATURAL RESOURCES

Energy Demand - General

During project construction, energy in the form of electricity and fossil fuels would be consumed. Electricity would be required to operate water pumps and lighting (if they are required). Fossil fuels, in the form of diesel, would be required for trucks transporting excess excavated materials, concrete and other materials and equipment to and from the project construction sites, and for operation of other heavy construction equipment. Fossil fuels, in the form of gasoline, would be required to transport employees between the project sites and their homes.

After completion of construction, the operational energy demands of the City's overall water supply system would be higher than current demands due to the addition of new facilities and expansion of the recycled water and groundwater systems under the proposed project. It is estimated that the proposed recycled water system would result in an additional energy demand of 14.7 million kilowatt-hours (kWh) per year, as detailed below, by site. This potential demand is equal to approximately 0.1% of the total annual electricity demand in 1980 by all users in the City and County of San Francisco, which was about 12.8 billion kWh.[1] The project-related increase in energy demand would be partially offset by the energy saved from pumping less groundwater (which is currently pumped for irrigation at Golden Gate Park and golf courses on the westside; see Section V.A.2, Groundwater and Surface Water Resources (p. 261). Current pumping requirements at Golden Gate Park are roughly estimated at 7.5 to 8.5 million kWh per year.[2]

Recycled Water Treatment Plant - Fleishhacker Pool Site

Operation of the pumps, filters, UV disinfection system, lights, and HVAC is estimated to require approximately 4.9 million kWh per year. The energy demand associated with the UV disinfection system would comprise 88% of the energy demand at the treatment facility and 33% of the total project-related energy demand. The pump station at this location is projected to use 8 million kWh, which would comprise 55% of the total project-related energy demand. The

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1 City and County of San Francisco, Department of City Planning, no date, *San Francisco General Plan, Environmental Protection Element.*

2 This estimate is derived from existing and projected connected horsepower (service) for the irrigation water system in Golden Gate Park of 1,165 hp and 1300 hp, respectively (Deborah Learner, San Francisco Recreation and Park Department, telephone communication with Valerie Geier, dated October 11, 1995), and assumes 0.75 kw/pump horsepower/hour of operation (CH2M Hill/AGS, Inc., *Groundwater Master Plan Technical Memorandum No. 13,* July 25, 1994) and maximum pumping demand of 24 hours/day, 365 days/year.

treatment facility and pump station energy demand would comprise 88% of the total energy demand associated with proposed recycled water facilities.

The proposed treatment facility would also be equipped with standby power. The emergency backup power system would include a 4,000 kilowatt generator, which provide sufficient power to pump 10 mgd of flow at 365 psi.

The proposed treatment plant facility would require extension of a new electrical power feed line to the project site. The nearest power feed is routed to the Oceanside WPCP and ends near the intersection of Skyline Drive and the Great Highway. Conduit and cable would be routed from this intersection to the proposed treatment facility and would need to be capable of meeting a peak power demand of approximately 3,000 kilovolt-amperes (kVA). The peak power demand of the project facilities was estimated based on peak influent pumping, peak recycled water pumping, and the peak number of filter backwash pumps and compressors in service.

Reservoirs

All reservoir sites would be located in developed areas where there are existing electrical facilities and no upgrading of existing facilities would be anticipated.[3] Electrical demand associated with reservoir operation would be minimal and associated with lighting, etc. Energy required to pump the recycled water to the storage reservoirs would be associated with pump stations at the tertiary treatment facility site (discussed above) and Lincoln High School site (discussed below).

Lincoln High School Pump Station. The proposed pump station at the Lincoln Reservoir is projected to use 1.8 million kWh per year. This would comprise 12% of the total energy demand associated with the proposed recycled water facilities. The proposed pump station would also be equipped with standby power. The emergency backup generator would provide 1,500 kilowatts of electricity, which would be sufficient to operate the pump station at maximum capacity (10 mgd). No upgrading of existing off-site facilities would be anticipated.[4]

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3 Dennis Gellerman, Montgomery Watson, telephone communication with Valerie Geier dated October 6, 1995.
4 ibid.

B. GROUNDWATER MASTER PLAN

B.1 LAND USE AND VISUAL

Introduction

This impact discussion first briefly addresses the types of wells that would be proposed for development under the GWMP. It then addresses the four specific, near-term production well projects (the Elk Glen Well and two Sunset District wells; the Powell Street BART Dewatering Reuse project; and finally, pipelines for these specific projects).

Monitoring Wells

Monitoring wells, once installed, would occupy less than one square foot of area, and installation would involve minimal site disturbance (see Section III.B, GWMP, Project Description, pp. 70 and 111). In general, no land use impacts would occur from monitoring well installation and operation. Under the Groundwater Master Plan, monitoring wells are proposed in the northern portion of the Westside Basin (the Richmond and Sunset districts) and in the Lake Merced area to monitor salt water intrusion. Monitoring wells could also be proposed as part of other groundwater resources studies and projects as the GWMP is implemented.

Production / Injection Wells

Individual production and injection well facilities could occupy an area ranging from 100 square feet to 640 square feet depending on the extent of associated electrical and disinfection/ treatment facilities necessary. Short lengths of small diameter pipeline would generally be required to connect the wells to storage and/or distribution facilities. Given the relatively small area these facilities occupy, little to no permanent land use conflict and incompatibility is generally expected. As specific well projects are proposed, the City will conduct additional CEQA environmental review as appropriate.

Elk Glen Well

Land Use

The proposed Elk Glen Well site in Golden Gate Park is currently occupied by the existing Elk Glen Well and pump, which are housed in a 13.5 by 27 foot chain link fence enclosure, five to ten feet from a path around Elk Glen Lake, and twenty-five to thirty feet from the lake. The lake

serves as a water system reservoir, and provides naturalistic setting for walking, horseback riding, resting, bird watching and other park enjoyment activities.

Use of the existing production well at the Elk Glen site would require the construction of a chlorination station and either rehabilitation or replacement of the well to ensure that the well meets the construction standards for public drinking water. If the well cannot be rehabilitated and needs to be replaced, SFWD would coordinate with the Recreation and Park Department to determine whether the replacement well could be installed in the immediate vicinity of the existing well or if there is another suitable location. Construction of a new well at the site would require well drilling as well as construction of a chlorination station. Under either scenario, about 1,800 to 2,000 square feet of area would be occupied with construction activities and staging for a construction period of up to eight weeks.

Once construction is complete, the new chlorination station and rehabilitated well would occupy about 640 square feet of park open space in the vicinity of the existing Elk Glen Well. The approximate location for the chlorination station has been identified on either side of an existing trail (see Figure 31, p. 99); the final location would be determined in coordination with the Recreation and Park Department in order to minimize impact to park use. The existing well, pump and fenced enclosure occupy an area of about 365 square feet, so the new facilities would permanently convert an additional approximately 275 square feet of open space to public utility use. If it is determined the existing well cannot be rehabilitated and used, then an alternative site would be identified and subsequent environmental review of the potential impacts associated with that site would occur at that time. The SFWD would work with the Recreation and Park Department to determine a suitable site (see Chapter VII, Mitigation Measure A-4). Whether the well is rehabilitated or a new well is constructed in the immediate vicinity, the surrounding open space would be regraded to its previous contours, and any affected vegetation would be replaced. The Elk Glen Lake trail would be restored to its pre-existing condition.

Increased noise, dust, and truck traffic associated with construction of the well would temporarily disrupt adjacent land uses, primarily park visitors walking, jogging or riding in the vicinity of Elk Glen Lake. Disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

Zoning

The Elk Glen site and surrounding area are zoned P, Public District, which permits public structures, such as the proposed well facilities, and uses of the City and County of San Francisco when in conformity with the Master Plan. A final decision regarding consistency with the San Francisco General Plan would be made by the City Planning Commission.

The character, maintenance and restoration of Elk Glen Lake and other Golden Gate Park lakes are discussed in the Golden Gate Park Master Plan.[1] The proposed well rehabilitation/construction would not substantially conflict with Golden Gate Park Master Plan policies. The Golden Gate Park Master Plan designates the site a "Naturalistic Parkland" area, and Objective I, Policy A, states that naturalistic parkland should be preserved to protect the pastoral character of the park. Although the proposed well facilities would displace a small additional area of open space beyond the existing well, these facilities would not greatly reduce recreational opportunities or the pastoral character in the Elk Glen Lake area (see visual impact discussion, below). The Rec Park Commission must make a determination of whether the proposed well and chlorination station are consistent with the City park uses. In the event the Commission determines they are not, the City Charter requires a public vote on the proposed use. For Golden Gate Park specifically, approval by the Board of Supervisors (2/3 majority) would also be required.

Visual

People walking on the Elk Glen Lake path currently have a proximate, unobstructed view of the existing pump and chain link enclosure on the well site. Pampas grass and shrubs lie between the path and the lake in the area adjacent to the site, partially obscuring views of the site from other portions of the lake perimeter. Views of construction activity and staging would be available to park visitors using the diverted Elk Glen Lake path and to other lake visitors in the vicinity for the estimated eight-week construction period.

Once construction is complete, a 640-square-foot, 15-foot-high concrete chlorination station would replace the 365-square-foot chain link enclosure, adding a single structure to an otherwise undeveloped naturalistic area. Vegetation would be planted around the structure to mitigate its effect on the natural setting (Chapter VII, Mitigation Measure A-6). Views of the completed structure would be available from the Elk Glen Lake path, and, to a lesser degree, from other areas around the lake. If a new well needs to be constructed instead of rehabilitation of the

[1] San Francisco Recreation and Park Department, *Golden Gate Park Draft Master Plan*, March 1995.

existing well, the SFWD would work with the Recreation and Park Department to determine whether the replacement well could be installed in the immediate vicinity of the existing well or if there is another suitable site (see Section VII, Mitigation Measure A-4).

Sunset District Wells

Land Use

New production wells and chlorination stations are proposed at two locations in the Sunset District: Francis Scott Key School and West Sunset Playground.

At Francis Scott Key School the well site is in the northeast corner of the school's only playground, which is used for lunch and recess play (see Figure 29, p. 95). In the corner of the playground proposed for the well site, there are two basketball hoops and a flagpole. The playground is entirely paved, and is flanked by school buildings to the west, and by residential development across the street to the north and east. During construction, construction activity and staging would occupy 1,800 to 2,000 square feet, about 2 percent of the approximately 90,000 square foot playground. For about eight weeks, this area would be unavailable for play.

Once construction is complete, a 640-square-foot concrete chlorination station would be permanently located in the northwest corner of the playground, occupying less than one percent of the school's play area. The surrounding play area would be restored following construction completion, and the basketball court(s) would be replaced adjacent to the site.

The West Sunset Playground site is located in a parking lot on the southwest corner of the West Sunset Playground complex (see Figure 30, p. 98). The parking lot is a paved area containing spaces for about 45 cars, and used by school and playground employees and visitors. The site is surrounded by residential uses and playing fields. There is an existing water sampling well adjacent to the proposed site, capped with the grade of the parking lot pavement.

During construction, construction activity and staging would occupy 1,800 to 2,000 square feet, about 8 percent of the approximately 23,450-square-foot playground. For about eight weeks, this area would be unavailable for parking. Once construction is complete, a 640-square-foot concrete chlorination station would be permanently located on the site, occupying about 3 percent of the parking area. The surrounding area would be restored following construction completion, and the

remainder of the parking area would return to its current use. Traffic/parking impacts are discussed in Section V.B.7, p. 418.

Increased noise, dust, and truck traffic associated with construction of the Sunset District wells would disrupt land uses adjacent to each site, including nearby school uses, residences, and playing field uses. Disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

Zoning

Both of the Sunset District well sites are zoned P, Public District, which permits public structures, such as the proposed well facilities, and uses of the City and County of San Francisco when in conformity with the General Plan. A final decision regarding consistency with the San Francisco General Plan would be made by the City Planning Commission.

Use of these sites for well facilities would not require any change in zoning and would appear to be consistent with San Francisco General Plan Recreation and Open Space Element Objective 4, Policy 2, which encourages maximization of "joint use of other properties and facilities."

Visual

Views of well facility construction activity, and of the completed chlorination station would be available from the schools and surrounding residences at the Francis Scott Key School well site, and from surrounding residential and parking uses at the West Playground Sunset well site. The completed 640-square-foot, 15-foot-high concrete chlorination station would not substantially alter the character of either of the Sunset well sites. Each site is in a developed environment, surrounded by paved area and existing concrete and wood structures.

Powell Street BART Station Dewatering Reuse

Land Use

The Powell Street BART Station Dewatering Reuse site is located within the Powell Street BART station, at the corner of Market Street and Powell Street in the Downtown Area of San Francisco (see Figure 31, p. 99). Existing surrounding land uses are high-rise business and transportation. An approximately 225-square-foot staging area would be located on the lower / outdoor level of the station, for the construction period of a maximum of a week. Completed

dewatering reuse facilities would be located within non-public-use areas of the station, except for a concrete valve vault adjacent to the escalators. Neither staging nor the completed facilities would substantially displace or affect existing BART user access.

Increased noise, dust, and truck traffic associated with construction of the dewatering reuse facility would temporarily disrupt land uses adjacent to each site, primarily BART users entering and exiting the station. Disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

Zoning

The site is within C-3-R and C-3-G Districts (Downtown Retail and Downtown General Commercial). Public service facility/utility installation is permitted within C-3-G, but requires Conditional Use approval within C-3-R. Use of the BART dewatering facility for the AWSS would be consistent with the site's existing zoning.

Visual

The valve vault site and staging area are visible from the Powell Street entrance and escalators. The remainder of the facilities are within areas of the station not open to the public and therefore not visible to the public. The new concrete valve vault would not affect the character of this urban transportation facility site.

Well Pipelines

Pipelines for the Elk Glen Well would run from the site along paved and soft surface park roads and paths to an existing water main about 120 feet away on Transverse Drive. Pipelines for the Sunset Well sites would be constructed in City streets from the sites to existing water mains on 28th Avenue or 30th Avenue. The streets along these routes are flanked mainly by residential uses, with some public facilities (schools) and mixed residential / commercial areas. The pipeline for the connection of the Powell Street BART dewatering facility to the AWSS would extend along public streets through Downtown retail and commercial use areas.

Construction and operation of pipelines would cause no temporary or permanent displacement of land uses along any route, because the pipelines would be constructed below grade and the routes would be restored to pre-existing contours, cover and use once construction is complete.

Increased noise, dust, and truck traffic associated with construction along specific pipeline alignments and general pipeline corridors could disrupt land uses adjacent to each site, including nearby school uses, residences, and businesses. Disruption of adjacent land uses due to construction noise, dust, and traffic is discussed in the relevant sections of this document.

B.2 GROUNDWATER AND SURFACE WATER RESOURCES

Introduction

This following impact analysis focuses on the long-term effects on groundwater and surface water resources associated with implementation of the GWMP. Due to the nature and subject of the GWMP, the identified effects are discussed at a program level. As specific projects would be proposed pursuant to the GWMP, those projects would be subject to further environmental review as necessary. This section is organized by issue, since the proposed GWMP would affect the groundwater and surface water resources on either a Citywide or basinwide basis. The project-level effects associated with the near-term activities proposed for immediate implementation are discussed relative to the basinwide effect.

There would be no project-related construction impacts to groundwater or surface water resources. Construction of proposed production wells at the Elk Glen and Sunset District sites would be required to meet the minimum construction standards set by the California Department of Water Resources, which are designed to protect the groundwater. Similarly, construction of monitoring wells would be required to meet City standards. Other proposed surface construction at these sites and at the Powell Street BART Station would be contained within a limited construction area (see Table 11, p. 107) protected from surface water resources.

Management of Groundwater Resources

The proposed GWMP would provide goals for the long-term management, development and use of groundwater resources in San Francisco where currently none exist. Even though groundwater has been developed and used throughout the City's history, historically and currently, there has been and is no centralized, comprehensive management structure for groundwater resources and no defined Citywide goals for its development and use. The GWMP would establish a management structure for groundwater resources, providing coordination between City agencies as well as with jurisdictions outside of San Francisco and providing oversight for both private and public users.

Currently, groundwater regulation in the City is divided between the San Francisco Water Department (SFWD), which is responsible for providing the City's water supply, and the San Francisco Department of Public Health (DPH), which is responsible for administering the well permit program. The California Regional Water Quality Control Board also has jurisdiction with respect to implementing the state's policy regarding groundwater degradation and groundwater

issues associated with leaking underground storage tanks. Groundwater users, either public or private, are required to obtain permits for construction, operation and abandonment of wells, but groundwater pumping is generally done on an individual basis without regard to Citywide or basinwide management issues. Implementation of the GWMP would establish a management structure with defined goals so that groundwater resources in the City could be developed in the most efficient manner while protecting and preserving groundwater as a long-term resource. The various field investigation and studies proposed under the GWMP, under the oversight of a defined management structure, would be intended to establish safe yield assessments and protect against long-term overdraft of the groundwater basins.

Goal 2 of the GWMP would be to "Coordinate groundwater use." This goal would form the basis of an institutional groundwater management structure, both internally within the City and externally with other jurisdictions. It provides for establishing the San Francisco Water Department (SFWD) as the lead in City groundwater management (Strategy 2A) and establishing a Groundwater Management Unit within the Water Department (Activity 2A1). Strategy 2B would improve coordination with adjacent entities that share groundwater basins with the City, and Activity 2C1 of the GWMP would establish groundwater management committees for the individual groundwater basins. For two of the basins (South and Downtown), the committee would involve only City departments and private landowners, and in the other five basins (Lobos, Marina, Westside, Islais Valley, and Visitacion Valley), the committees would bring together other jurisdictions and local utilities as well as City departments and private landowners. Management of groundwater on a basinwide-basis would facilitate coordinated groundwater pumping, storage and monitoring, and would enable the basins to be maintained as long-term resources.

Implementation of Goal 2 and the associated long-term strategies and short-term activities (see Figure 21, p. 72) would, in fact, be necessary to ensure successful implementation of the four other stated goals in the GWMP. Without the overall management structure provided for under Goal 2, the purpose and results of the various studies and field investigations proposed under Goals 1, 3, 4 and 5 could not be effectively coordinated.

Groundwater Quality

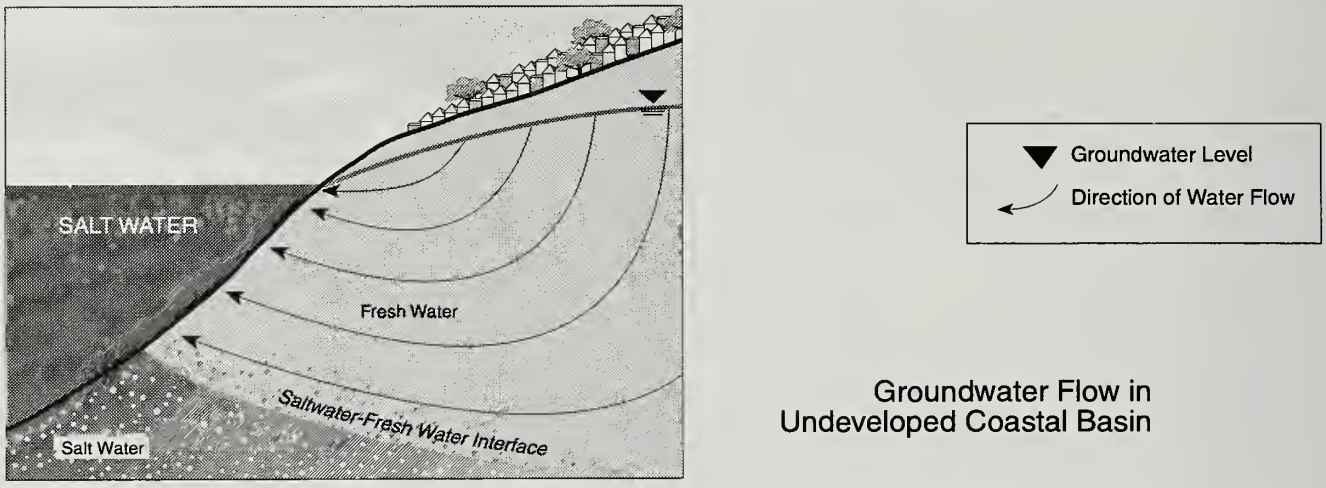
Implementation of the GWMP would lead to long-term protection in groundwater quality throughout all the City's groundwater basins. Goal 1 of the GWMP is "To protect and enhance groundwater quality," and the three approaches proposed to accomplish this are: (1) to prevent

seawater intrusion, (2) to develop a wellhead protection program, and (3) to develop a comprehensive groundwater monitoring program.

Saltwater Intrusion Prevention

Saltwater intrusion is the increase in salinity of groundwater due to migration of saltwater caused by groundwater pumping. It could potentially occur in any of the City's seven groundwater basins, since all are open on at least one side to saltwater, either from the ocean or the bay. Figure 58 depicts a typical scenario in a coastal aquifer where saltwater intrusion occurs. Freshwater located in the groundwater basin occurs above the more dense saltwater, and the divide between the saltwater of the ocean and the fresh water of the aquifer is termed the "saltwater-freshwater interface." In the San Francisco groundwater basins, in the absence of groundwater pumping, the interface of the freshwater and the saltwater is extended at depth offshore over the ocean or bay due to the outflow of freshwater from the aquifer (see Figure 58a). As groundwater pumping occurs, the localized flow of groundwater in the basin moves toward the well, and depending on the rate of pumping compared to the rate of recharge, the interface of freshwater and saltwater can migrate landward (Figure 58b). If over-pumping occurs, the quality of the groundwater being pumped in the well will show characteristics of seawater (i.e., higher levels of salts and chloride) and may no longer be suitable for potable use, resulting in saltwater intrusion (Figure 58c). The aquifer is particularly susceptible to saltwater intrusion during drought periods when natural recharge is low and groundwater pumping may be increased. Saltwater contamination of a freshwater aquifer is generally not reversible.

Any proposed groundwater development, such as would occur under Goals 4 and 5, could increase the potential for saltwater intrusion unless appropriate measures, such as those proposed under Goal 1, are implemented. The GWMP would include studies to evaluate the potential for saltwater intrusion, such as hydrologic modeling to predict possible effects of various levels of groundwater extraction. As groundwater development occurs, the City would develop a saltwater intrusion prevention network, which would include monitoring wells for monitoring the groundwater for indications of movement of subsurface saltwater. If monitoring were to indicate a trend toward saltwater intrusion, the two possible actions would be: (1) to either reduce pumping from the production wells, and/or (2) to use injection wells for injecting alternate freshwater sources to counter the flow of saltwater. At this time, the GWMP mentions the potential use of injection wells in the saltwater intrusion prevention network.



SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 58
Stages of Saltwater Intrusion

If injection wells are determined by the City to be a feasible approach to preventing saltwater intrusion, further environmental review would be necessary at that time. Potential impacts associated with use of injection wells would depend on the proposed extent and location of injection and the potential alternate water sources for injection.

Computer modeling of saltwater intrusion has already been initiated in the northern portion of the Westside Basin to evaluate proposed pumping in the Sunset District.[1] The purpose of the model is to estimate safe pumping limits and to determine the most suitable locations for the proposed production wells. This was done by using existing groundwater information and developing a computer model to simulate groundwater flows, to predict the location of the saltwater/freshwater interface, and then to predict the combination of pumping rates that would not cause saltwater extraction in the wells.

The saltwater intrusion model consists of a saltwater intrusion routine, which is a series of density calculations, that is run iteratively with the groundwater flow model. Using existing pumping data on active wells in Golden Gate Park and various previous studies on groundwater flow in the Westside basin, the freshwater-saltwater interface was estimated based on average pumping and recharge conditions. Nine various pumping scenarios were then tested for the effects on the saltwater-freshwater interface by the proposed new production wells in the Sunset District and the rehabilitation of the Elk Glen Well. Of the scenarios modeled, two combinations of pumping rates and well locations produced the most groundwater without saltwater extraction occurring. These two scenarios indicated that the amount of groundwater that can be extracted without causing saltwater intrusion depends on the total recharge area and the existing pumping and is less affected by the actual well location. In conclusion, the preliminary saltwater intrusion modeling indicates that the proposed development of additional groundwater pumping in the Sunset District is feasible and appears to have minor effects on the local groundwater budget in the Lake Merced area (less than 40 ac-ft/yr). It is estimated that 800 to 1,000 ac-ft/yr of additional groundwater can be extracted from the Westside Basin north of Lake Merced without causing saltwater extraction in the existing or proposed production wells in the area. The model recommends, however, that in order to minimize the impact of saltwater intrusion, further development of groundwater pumping in this area consider two important factors: (1) future pumping rates at existing wells in Golden Gate Park, taking into account any proposed expansion of pumping as well as the RWMP; and (2) that because the preliminary modeling was based on

[1] CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan, Technical Memorandum 14, Saltwater Intrusion Model,* May 12, 1995.

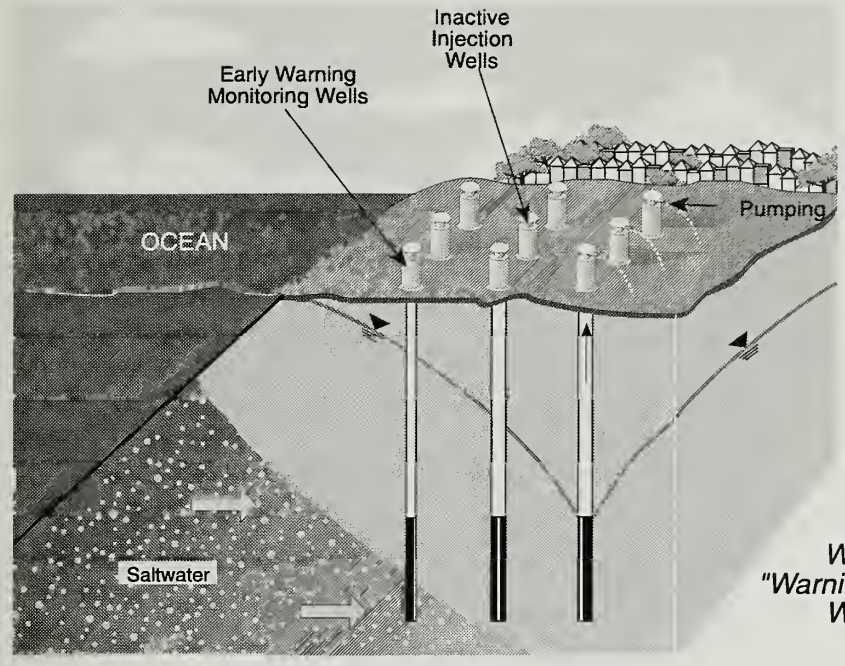
limited data, the proposed scenarios be implemented in a staged approach with a sampling and testing plan to allow the City to collect additional data to confirm or modify the model results.

The proposed activities to prevent saltwater intrusion include ongoing development and refinement of the groundwater model as additional hydrogeologic data are collected (as part of Activity 1C1). Activity 1A2 would be the development and implementation of a saltwater intrusion prevention network, that would include monitoring wells located between the estimated present saltwater interface and any existing or proposed production wells (Activities 5A1 and 5A2). The saltwater intrusion model would also be used to identify the areas most susceptible to saltwater intrusion so that appropriate monitoring wells can be installed as part of the saltwater intrusion prevention network (Activity 1A2). During operation of the existing and proposed production wells, water levels and water quality indicators would be routinely collected and evaluated to manage groundwater pumping within the basin to prevent saltwater intrusion. If the monitoring indicates that groundwater pumping is causing the saltwater interface to move landward and jeopardize the water quality of existing or proposed production wells, either pumping could be reduced or halted, or implementation of injection wells could be evaluated. Figure 59 depicts a typical system of monitoring wells and injection wells that could be used as part of a saltwater intrusion prevention network. Implementation of Short-term Activities 1A1 and 1A2 under Goal 1 concurrently with any development and use projects under Goals 4 and 5 would reduce the potential for saltwater intrusion.

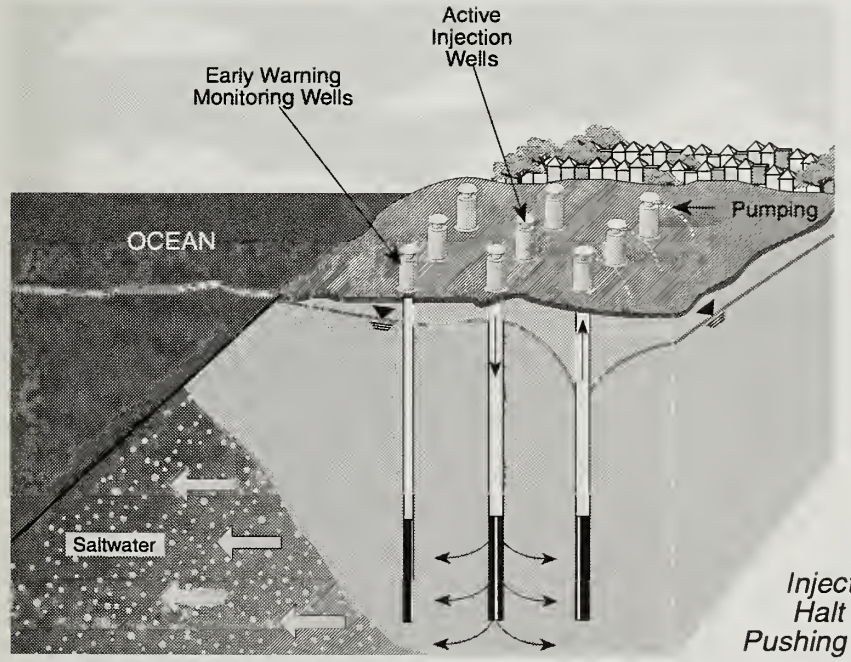
Wellhead Protection

Hazardous materials or wastes that have been improperly handled are known to result in contamination in the soil or groundwater; and there are numerous identified and unidentified contaminated sites throughout the City (see Section IV.F, Hazardous Materials Setting, p. 204). Handling of hazardous materials associated with various land uses (such as service stations handling gasoline, or dry cleaners handling organic solvents) results in the potential for hazardous waste contamination, either through improper handling or accidental spills. Contaminated sites, or potentially contaminated sites, are potential sources of groundwater quality degradation at both existing and proposed groundwater development sites, since hazardous wastes in soil can leach to the shallow groundwater, which, depending on localized hydrogeologic condition, could potentially infiltrate to deeper groundwater.

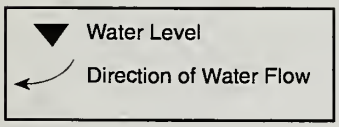
With the proposed development of groundwater for potable uses, the GWMP would include the development and implementation of a wellhead protection program (Activity 1B1). This



Water Quality Data from "Warning System" Monitoring Wells Indicate Saltwater Intrusion is Beginning



Injection Wells Activated to Halt Saltwater Intrusion by Pushing Saltwater Oceanward



SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

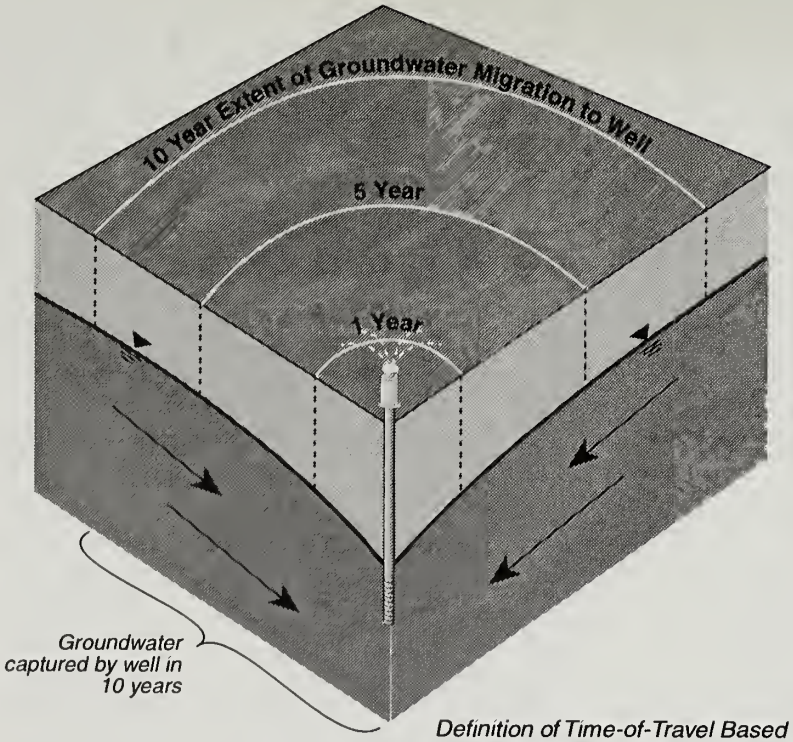
SF RWMP/GWMP Program EIR ■

Figure 59
Warning Well System Schematic

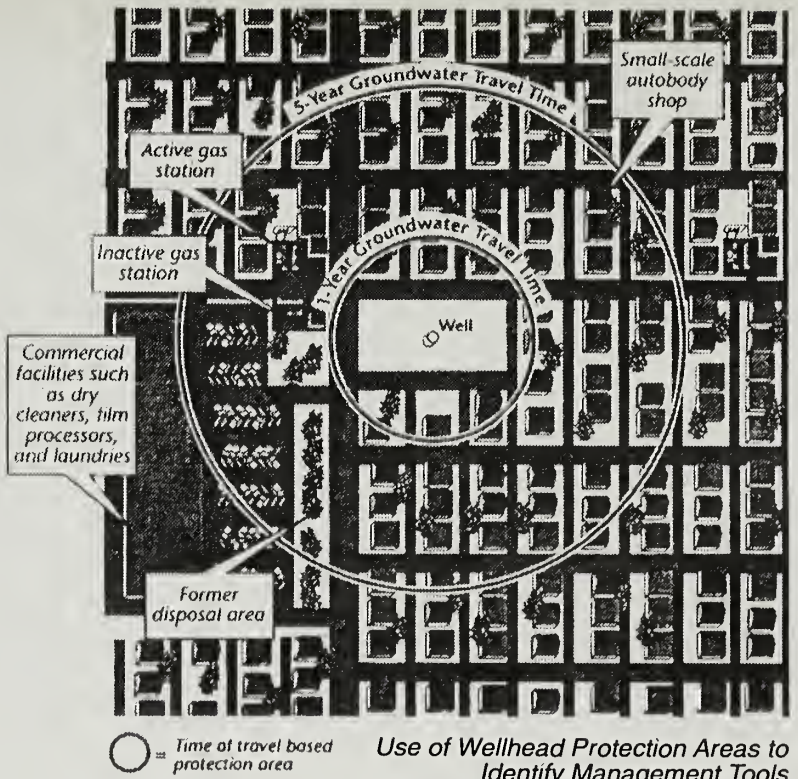
program would locate potential sources of groundwater contamination within a specific protection area in the vicinity of the wellhead (top of the well) and would reduce the risk of these potential sources affecting groundwater quality. The program would include measures such as working with the RWQCB to identify high-priority clean-up sites to protect the water supply from known contaminants within a "wellhead protection area." The wellhead protection program would include revising the well permit approval process to minimize potential groundwater contamination. The revised permit process would include the following: a complete plan describing well construction details; a delineation of wellhead protection areas; an analysis of the proximity of the proposed new well to potential contamination sources; an analysis of potential contaminant travel time; a proposed groundwater quality sampling program, and an analysis of potential effects of the proposed new well on saltwater intrusion and other environmental considerations.

Figure 60 depicts a wellhead protection area, showing typical land uses which are potential sources of contamination (i.e., active and inactive gas station, small-scale auto body shop, former disposal area, and commercial facilities such as dry cleaners, film processors, and laundries). The wellhead protection area would be based on the groundwater travel time to identify an appropriate zone around each well that would provide an acceptable level of groundwater protection.

Currently, the Department of Public Health is responsible for well permitting in the City for the construction, use and abandonment of water wells under Article 12B, Chapter V (Health Code) of the San Francisco Municipal Code. The permitting process includes minimum standards for well construction, identification of disposal areas or underground tanks within 500 feet of the well, minimum distances from potential sources of pollution, and water quality monitoring, inspection and reporting. The current regulations are in process of revision (see Appendix B), and many of the components of the proposed wellhead protection program are incorporated into the proposed revision. However, under the GWMP, implementation of the various components of a typical wellhead protection program, under the management structure provided in Goal 2, would expand upon the scope of the permitting process to incorporate the overall goals of the GWMP and would therefore provide an increased and broader level of long-term protection to groundwater quality, relative to the current system of well permitting.


10 Year Extent of Groundwater Migration to Well
5 Year
1 Year
Groundwater captured by well in 10 years
Water Level
Direction of Water Flow

Definition of Time-of-Travel Based Wellhead Protection Areas


5-Year Groundwater Travel Time
1-Year Groundwater Travel Time
Small-scale autobody shop
Active gas station
Inactive gas station
Well
Commercial facilities such as dry cleaners, film processors, and laundries
Former disposal area
= Time of travel based protection area

Use of Wellhead Protection Areas to Identify Management Tools (Potential pollution source inventory is shown)

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 60
Definition of Time-of-Travel Based Wellhead Protection Areas, and Use of Wellhead Protection Areas

92.371E
(ESA 910641)
SF RWMP/GWMP
November 1, 1996

Groundwater Monitoring

Under Activity 1C of the GWMP, the City would develop and implement a City-wide, long-term groundwater monitoring program with the objective of establishing a groundwater database on water levels, extractions, and quality. The annual monitoring program would encompass both private and public wells, and dewatering, irrigation, production/extraction, and monitoring wells, and possibly measurements of surface water features (such as Lake Merced or Lobos Creek) that are interrelated to the groundwater. The database would then form the basis of informed management decisions, again, under the management structure provided in Goal 2. The monitoring program could encompass a range of monitoring parameters, depending on the designated use of individual wells. For example, potable water wells could be tested for compliance with drinking water standards, while irrigation wells could be tested for nitrate, and saltwater monitoring wells could be tested for chloride and salts. The data could also be used to develop and update groundwater models proposed as short-term activities under the GWMP, such as the saltwater intrusion model.

Currently, there is no such Citywide program for groundwater monitoring, with limited requirements for monitoring included in the well permitting process. The proposed comprehensive, long-term groundwater monitoring program and establishment of a groundwater database would provide ongoing assurance of the protection of groundwater quality, as well as a measure of effectiveness of the overall GWMP.

Conjunctive Use

As discussed in Chapter III (p. 29), conjunctive use is the coordinated management of groundwater and surface water supplies to increase the overall availability of water during droughts or other periods of need. Implementation of Strategy 5C of the GWMP, which proposes conjunctive use programs in San Francisco, would require comprehensive and coordinated management efforts throughout an individual groundwater basin, as proposed under Goal 2. It would result in efficient long-term use of available water resources, by reserving water resources during wet years for use during dry years. The GWMP proposes two programs for conjunctive use as discussed below.

One program, proposed under Activity 5C1 for the Westside Basin, would be for the City to provide imported surface water to groundwater users in the southern part of the basin during periods when surplus surface water is available. In exchange, the groundwater users would

reduce or cease groundwater extraction during these periods, and during dry years when surface supplies are limited, the groundwater would be available for pumping. This type of conjunctive use program is known as "in-lieu recharge." The aim of in-lieu recharge is to let the aquifer naturally recharge by halting or reducing extractions. In years of adequate and/or surplus surface water supply, the groundwater would accumulate in basin storage to be used in years of inadequate surface water supply. Conjunctive use of the groundwater basin could also help counter declining water levels in Lake Merced that are associated with downward hydraulic gradients from deep well pumpage. The City has already initiated discussions with the cities of Daly City and San Bruno and with the California Water Service Company regarding in-lieu recharge. Successful implementation of this program would relieve reported overdraft conditions identified in the southern part of the Westside Basin and could also offset declining water levels in Lake Merced.

Another potential conjunctive use program presented in the GWMP could be used in the Lobos Basin (Activity 5C2), where in-lieu or active (i.e. using injection wells) recharge could be used. However, due to the ongoing and planned land use changes at the Presidio, the future water demands are anticipated to be reduced from historic levels, and groundwater pumping may be reduced regardless of the GWMP. Coordination between the City and the National Park Service, as proposed under Goal 2 of the GWMP, would be necessary to determine the most efficient use of available water resources in Lobos Creek and Lobos Basin and the potential for a conjunctive use program. Additional investigations for the Lobos Basin as proposed under the GWMP (Activities 3B1, 5C2 and 5D1) as well as additional environmental review for specific actions would be necessary prior to conducting conjunctive use in the Lobos Basin.

Impacts on Lake Merced and Other Surface Waters

Goal 3 of the GWMP would "Protect and Conserve Related Water Resources." Specifically, this goal would provide protection for lakes and surface streams that are interconnected with the groundwater system, with Lake Merced and Lobos Creek as the main focus of identified short-term activities. Implementation of the strategies and activities proposed under this goal in conjunction with proposed management activities (under Goal 2) and monitoring activities (under Goal 1) would protect and conserve the surface water resources such as Lake Merced or Lobos Creek.

In order to implement the GWMP goal of coordinated groundwater use with respect to Lake Merced, it is assumed that under Activities 1C1, 3A1 or 3A2, a groundwater monitoring program

would be developed and implemented, involving collection of data on groundwater levels, extractions, and water quality as well as water levels at Lake Merced. The data would be maintained on a GIS database for use in identifying and interpreting declines and increases/improvements in groundwater quality and quantity. Long-term sampling for water quality parameters such as pH, total coliform, nitrogen, chloride, iron, manganese and organic compounds associated with golf course applications of herbicides and pesticides would allow the Water Department to establish baseline constituent loadings adjusted by seasonal variations for the Lake Merced area. The effect of implementing various lake management practices on groundwater quality could then be tested against baseline conditions. In addition, under Activity 3A1 of the GWMP, a field investigation would be conducted at Lake Merced to provide detailed information for further refinement of the existing Lake Merced groundwater model. The field program would be focused on collecting information to better understand the degree and extent of communication between aquifer layers, to establish static groundwater levels, and to estimate groundwater outflow to the ocean.

Data collected in Activity 1C1 would establish a reliable baseline of groundwater information throughout the Westside Basin, while data collected in Activity 3A1 would assist the Water Department in refining the groundwater model as a local groundwater management tool. Under Activity 3A2, the current Lake Merced groundwater model[2] would be updated with data from Activity 3A1 field investigations, from the USGS, and from the Bay Area Water Users Association and, thus, would facilitate the incorporation and comparison of various data sets. The model could be used to simulate various recharge and pumping scenarios for evaluation by the Westside Basin Committee (Activity 2C1, AB 3030 management committee) during the process of developing alternative lake management practices. It is the Water Department's intention that the Lake Merced groundwater model eventually be expanded and calibrated with new baseline data to cover the entire Westside Basin and become a useful basin-wide management tool.

Similarly, proposed studies on Lobos Creek (Activity 3B1) together with a groundwater monitoring program in the Lobos Basin (Activity 1C1) would provide a basis for better understanding the potential for development of the Lobos Creek surface water/groundwater system. This improved database under the coordinated management of the system between the City and the National Park Service, as proposed under Strategy 2C, would be necessary to achieve the goal of protecting and conserving the water resources of Lobos Creek.

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[2] GeoResources Consultants, Inc., *Lake Merced Water Resource Planning Study,* prepared for the San Francisco Water Department, May 1993.

Currently, the City has limited reliable long-term groundwater monitoring data at representative sites that can be used to model comprehensively groundwater conditions that affect surface waters in the various basins in the City. Implementation of the proposed GWMP monitoring and modeling activities would improve the City's ability to protect, conserve and enhance the groundwater resources that sustain Lake Merced, Lobos Creek, or other surface water bodies by better understanding controlling variables and by the ability to model potential effects of proposed development activities or management practices.

Emergency Water Use

Goal 4 of the GWMP is to "Improve ability to deliver water during emergencies." Lake Merced has been designated as an emergency water supply, and due to water quality constraints, it may be more suitable for non-potable emergency use such as fire fighting rather than for potable water. In order to be used for fire fighting, Lake Merced water would need to be delivered to the auxiliary water supply system (AWSS) to be an effective fire fighting supply for the San Francisco Fire Department. However, since the AWSS does not extend to the Lake Merced area, it has been suggested that delivery of Lake Merced water into the AWSS could be accomplished by transmitting lake water through the SFWD potable water distribution system.[3] However, this would pose a public health problem. Although lake water for emergency purposes would likely be disinfected with sodium hypochlorite, the public would then need to be notified of a Boil Water Order and Unsafe Water Alert to prevent direct consumption of the water if Lake Merced water were to be transmitted through the potable water distribution system. Thus, the current feasibility of using Lake Merced as an emergency water supply source has not been fully resolved, and is not proposed at this time.

As part of a strategy to meet the GWMP goal of using City groundwater resources as an emergency reserve, the SFWD would evaluate the possibility of installing large-capacity standby wells to meet emergency needs (Activity 4A1). Any such wells would be subject to environmental review if and when proposed. With the assumption that the location, capacity, and likely duration of use of emergency wells would be modeled to prevent saltwater intrusion and to reduce the risk of future groundwater contamination (GWMP Strategies 1A and 1B), the design, installation and operation of emergency wells could improve the City's capacity to provide water during emergency situations.

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[3] GeoResources Consultants, *Lake Merced Water Resources Planning Study*, prepared for the San Francisco Water Department, May 1993.

Project Effects of Near-Term Activities

Elk Glen and Sunset District Wells

The proposed groundwater production wells at the Elk Glen and Sunset District sites would extract up to 1,000 ac-ft/yr.[4] This proposed rate of extraction was determined based on extensive hydrologic modeling supported by field data to prevent saltwater intrusion and to prevent subsidence and is subject to refinement as additional data would be collected during the initial stages of project implementation, as discussed below. The final decision regarding the pumping rate of the Sunset District wells and the pumping rate of the Elk Glen Well would be based on aquifer testing and water quality testing at test wells at each of the proposed sites and on computer modeling of saltwater intrusion. This staged approach to well installation and development would assure that the proposed production wells would not result in water quality degradation (including saltwater intrusion and wellhead protection). In addition, the staged approach would assure that proposed changes in the water balance of the groundwater system would be within the safe yield of the basin.

The first step in the installation of the Sunset District wells would be to verify the preliminary hydrologic evaluations based on installation of test wells and site-specific aquifer testing. Hydrologic evaluations conducted to date indicate that two wells would be installed at the West Sunset Playground and Francis Scott Key School sites.[5] A test well was drilled and aquifer testing was conducted at the West Sunset Playground site in 1993, and a similar procedure would be conducted at the Francis Scott Key School site. A test well would likely consist of a six-inch well drilled to a depth of about 350 feet below ground surface at a site 50 to 200 feet away from the ideal production well location at the Francis Scott Key site. Once completed, the test well would be used to conduct aquifer testing and limited water quality testing to determine site-specific hydrogeologic conditions for the aquifer.

At the Elk Glen Well, tests would be performed to determine if the well meets construction standards for public drinking water supply wells. Based on the results, the well would either be rehabilitated or a new well installed in the immediate vicinity at a location to be determined in coordination with the Recreation and Park Department. Water quality and aquifer testing could be done at the existing well.

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4 CH2M Hill, Memorandum from Toni Pezzetti, CH2M Hill to Joyce Hsiao, Orion Environmental Associates, dated March 3, 1995.

5 CH2M Hill/AGS, Inc., San Francisco Groundwater Master Plan, Memorandum dated August 2, 1995 regarding *Proposed Approach to Installing Sunset District Production Wells.*

Data from the aquifer testing at the various test wells would be used to estimate pumping rates for the proposed production wells. The saltwater intrusion model can then be run using the estimated pumping rates for the proposed production wells (Sunset District and Elk Glen Wells) and any changes in pumping rates in other existing wells in Golden Gate Park. The results of the saltwater intrusion model would be used to determine optimum pumping rates at the wells based upon aquifer characteristics and the minimization of saltwater intrusion. The model would also be used to identify the areas most susceptible to saltwater intrusion so that appropriate monitoring wells can be installed as part of the saltwater intrusion prevention network (Activity 1A2).

In addition to the aquifer test, water quality testing would be conducted at the Elk Glen Well, the West Sunset Playground test well, and the Francis Scott Key School test well. The water would be tested for the full range of drinking water parameters regulated under Title 22 of the California Code of Regulations. The results of the water quality testing would be used to determine the suitability for drinking water use and if any treatment would be required prior to distribution to the public water supply system.

Based upon the water quality and hydrologic testing, estimates of saltwater intrusion, and water budget issues, the precise location of production wells would be determined. Prior to installation of the full-scale production wells, however, wellhead protection measures would be implemented, as discussed above for the GWMP (Activity 1B1). This would include delineation of a preliminary protection area for the Elk Glen and Sunset District wells and identification and surveys of potential groundwater contamination sources within this area. Completion of all of the wellhead protection components, such as analysis of potential contaminant travel time and a groundwater quality sampling program, may not occur until after the drilling and testing the test well.

Following final design and installation of the production wells, saltwater intrusion monitoring wells would be installed as determined by the saltwater intrusion model, and monitoring would begin at these any other available wells in the vicinity. Actual pumping from the new production wells would occur in a staged approach such that initial pumping would be lower than the estimated optimum rate. Using monitoring data (water quality and water level) from the saltwater intrusion monitoring wells and other available wells, the saltwater intrusion model would be run again with pumping rates at the observed rates to validate the model. Optimum pumping rates would then be revised if necessary, and the proposed production wells could then be pumped at the optimum rates. During operation of the production wells, water quality and

water level monitoring at the saltwater intrusion monitoring wells and other available wells would be done to assure that groundwater resources are protected from saltwater intrusion as well as from wellhead contamination (see Chapter VII, Mitigation Measure B-9).

Goals 1, 2 and 3 of the GWMP focus on groundwater management measures to protect, conserve, monitor, and enhance groundwater quality and quantity. The first three goals and associated strategies/activities establish important safeguards for protection of groundwater resources from potential adverse effects of any groundwater development projects proposed under Goals 4 and 5, such as the Elk Glen and Sunset District wells. Thus, due to the comprehensive nature of the GWMP, goals and strategies to monitor and to protect the groundwater resources that would potentially be affected by groundwater development projects have been incorporated into the plan.

Powell Street BART Station Dewatering Facilities

The proposed transfer of groundwater from existing dewatering pumps at the Powell Street BART Station to the AWSS would increase the efficiency of currently non-potable groundwater use. At present, the dewatering pump station at the Powell Street BART Station is used to divert about 150 ac-ft/yr of groundwater from the underground BART facilities to the sewer that runs along Market Street. The proposed project would construct facilities to extract water from the BART dewatering system and inject it into the City's auxiliary water supply system (AWSS) for use in fire fighting. The AWSS system requires an estimated 225 ac-ft/yr of water to compensate for pipeline leakage,[6] which is generally supplied by SFWD potable water. The dewatering from the Powell Street BART Station would therefore replace about two-thirds of the replenishment water supply needed for the AWSS, which in turn would reduce demands on the potable water system and make available the SFWD water for uses requiring the higher quality water. This additional/substitute water source would also result in increased reliability of the AWSS system, particularly during drought conditions. There would be no net changes in the groundwater budget in the basin, since only the location of the dewatering discharge would change and the existing groundwater extraction rates would remain the same. Similarly, no changes in groundwater quality would be expected.

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6 CH2M Hill/AGS, Inc., *Technical Memorandum 12c* (regarding Design of Facilities to Capture Groundwater Produced by Dewatering Operations), prepared June 27, 1994 and revised March 28, 1995.

B.3 PUBLIC HEALTH AND WATER QUALITY

Introduction

This section is organized by topic, and the effects of groundwater are evaluated generally on a program level. Project-specific water quality analysis is provided regarding the potential use of groundwater from the Elk Glen and Sunset District wells.

Potable Groundwater

The proposed GWMP's strategies and short-term activities for development of additional groundwater wells for potable water usage to supplement the City's public water supply system would be regulated under the federal and state Drinking Water Standards and administered through the City's Water Department and Department of Public Health. Regulation and management of the supplemental system would be similar to the current management of the City's water supply system.

Development of the supplemental supply would be predicated upon the determination, based upon subsequent field testing, that groundwater quality would provide the same level of public health protection as the current water supply. The Water Department would monitor the groundwater quality to assure that potable water supplies would consistently and reliably comply with the primary and secondary Drinking Water Standards for all designated potable uses in the GWMP, including individual potable users, local distribution system users and main distribution system users (see GWMP Project Description, pp. 89 to 90). As stated in the GWMP, for individual potable users (such as schools or large retail or commercial complexes), the San Francisco Water Department (SFWD) could extract, treat and deliver groundwater directly to the users. For local distribution users, the SFWD could extract, treat and inject groundwater into the potable water distribution where it would blend with other SFWD water supplies prior to distribution to the users. For main distribution system users, the SFWD proposes to extract, and either treat or blend groundwater with surface water, before injecting it into the potable water distribution system; in either case, the treated or blended water would need to meet Drinking Water Standards prior to injection to the distribution system. If the groundwater meets Drinking Water Standards, then it could be injected directly into the distribution system without treatment or blending.

The proposed Elk Glen Well and the Sunset District wells would feed into the City's potable water main distribution system, where the groundwater would blend with the City's other potable water sources. The water could then be distributed to anywhere in the SFWD's distribution system service area. Chlorination stations are proposed at each well location to treat the groundwater and to assure that appropriate disinfection of water supplies would occur prior to injection of groundwater to the main distribution system. Monitoring of the water quality and appropriate disinfection of the groundwater prior to injection to the potable water distribution system would provide protection of public health as required by state and federal drinking water regulations.

Based on preliminary field investigations of groundwater quality in ten wells in the Westside Basin conducted in 1993, the water quality generally appears to meet Drinking Water Standards.[1] However, there appears to be some variation in groundwater quality across the Westside Basin, and exceedances of the Drinking Water Standards were observed in three of the ten wells for levels of coliform (Stern Grove well), iron (West Sunset Playground well) and manganese (Oceanside WPCP well) during this one-time sampling event.

Results from samples collected in 1993 from the existing Elk Glen irrigation well and the West Sunset Playground test well as part of this field investigation are summarized in Table 40. Both wells extract groundwater from more than 150 feet below ground surface. For the constituents measured, groundwater in both wells met all primary drinking water standards (health-based, legally enforceable standards); however, most, but not all, drinking water parameters were measured. The only constituent exceeding any standard was iron in the West Sunset Playground well, which was 0.399 milligrams per liter (mg/L), compared to the secondary standard (aesthetic standard, not enforceable) of 0.3 mg/L. If this groundwater were injected into the distribution system and blended with other SFWD water supplies, the resultant blended water would likely meet all Drinking Water Standards. The results of this preliminary water quality testing provide an indication that the groundwater meets Drinking Water Standards, but additional, comprehensive monitoring of all constituents regulated under Title 22 Drinking Water Standards would be required to assure full compliance of the potable water quality from the proposed production wells.

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[1] CH2M Hill/AGS, Inc., *San Francisco Water Department Groundwater Master Plan, Technical Memorandum 8, Westside Basin Field Investigation Program*, January 31, 1994.

TABLE 40: GROUNDWATER QUALITY (all units mg/L unless otherwise noted)

Parameter	Elk Glen Well /1/	West Sunset Playground Well /2/	Daly City Groundwater /3/	SFWD Drinking Water /4/	Drinking Water Standards /5/
Total Dissolved Solids	350	165	325	61	500 (S)
Specific Conductance, umho/cm	570	280	no data	101	900 (S)
pH, units	7.7	7.9	7.7	8.6	6.5-8.5 (S)
Total Coliform /6/	<2	4	0	0.7	5% of samples positive (P)
Turbidity, NTU	<1	<1	0.13	0.2	5 (S)
Odor Threshold, units	<1	<1	<1	<1	3 (S)
Calcium	399	158	27	24	no standard
Magnesium	425	157	29	10	no standard
Sodium	307	231	44	9.1	no standard
Chloride	38	21.2	63.2	12.9	250 (S)
Sulfate	38	23.5	24.6	5.6	250 (S)
Hardness, as $CaCO_3$	234	98	186	33	no standard
Nitrate	10.4	4.1	38	0.46	45 (P)
Potassium	no data	no data	1.6	0.5	no standard
Arsenic	<.002	<.2	non-detect	0.001	0.05 (P)
Barium	0.027	<.01	non-detect	0.01	1.0 (P)
Cadmium	<0.01	<0.01	0.0007	<0.001	0.005 (P)
Chromium	0.024	0.024	0.022	<0.001	0.05 (P)
Copper	<0.001	0.0015	non-detect	<0.001	1.0 (S)
Iron	<0.05	0.399	non-detect	0.112	0.3 (S)
Lead	<0.001	<0.001	0.002	<0.001	0.015 (P)
Manganese	<0.005	0.019	non-detect	0.009	0.05 (S)
Mercury	<0.0002	<0.0002	non-detect	<0.001	0.002 (P)
Nickel	no data	no data	no data	0.002	0.1 (P)
Selenium	<0.001	<0.2	non-detect	<0.002	0.05 (P)
Silver	<0.02	<0.01	non-detect	<0.001	0.1 (S)
Zinc	no data	no data	0.05	<0.005	5.0 (S)
Organic Chemicals	all non-detect	all non-detect**	all non-detect	all non-detect *	Varying

/1/ Elk Glen Well located in Golden Gate Park; sample collected 11/3/93.

/2/ West Sunset Playground sample collected 12/21/93. Well is screened in the deep aquifer 150-330 feet below ground surface. **All organic chemicals non-detect except for chloroform at 0.8 ug/l, which has no standard.

/3/ City of Daly City Annual Water Quality Report for 1990, groundwater, average value. Data represent southern part of Westside Basin.

/4/ SFWD drinking water data are from San Francisco Water Department 1994 Annual Water Quality Report, average values. Not all parameters shown. About 85% from Hetch Hetchy, 15% from local watersheds. *All organic chemicals non-detect except total trihalomethane, at 0.018 mg/l compared to standard of 0.10 mg/l.

/5/ Drinking Water Standards include primary standards, noted with (P), also known as maximum contaminant levels, which are legally enforceable under the Safe Drinking Water Act. Lead standard shown is the federal action level, which is non-enforceable health-based guidance number. Secondary standards, noted with (S), are aesthetic standards and are not enforceable. Source: California Department of Health Services, Division of Drinking Water, November 1994.

/6/ Total coliform at the Elk Glen and West Sunset Playground wells is measured in MPN/100 ml, which is a measure of the bacteria colonies; these values are from one-time sampling events and cannot be compared to the Drinking Water Standard. The Drinking Water Standard for total coliform, applicable to the Daly City groundwater and the SFWD drinking water, is measured in percentage of samples with positive readings for the presence of total coliform bacteria. No more than 5% of the number of samples collected during any month can be positive for total coliform, with a minimum of 40 samples required per month.

MPN = Most Probable Number; NTU = Nephelometric Turbidity Unit; umho/cm = micromho per centimeter

SOURCE: Orion Environmental Associates, 1995.

Table 40 also includes average values for groundwater data from Daly City, which extracts groundwater from the southern part of the Westside Basin for drinking water. The groundwater quality in the southern part of the basin shows higher levels of nitrate and chloride and lower levels of calcium, magnesium and sodium than the northern part of the basin (as indicated by the one time sampling from the Elk Glen and West Sunset Playground well), and the overall water quality meets Drinking Water Standards. The data indicate that proposed development of the Elk Glen Well and the Sunset District wells in the Westside Basin for potable water usage would meet all drinking water standards, assuming that appropriate disinfection (i.e., proposed on-site chlorination) and water quality monitoring would be conducted. Implementation of the proposed production wells would, therefore, not be expected to result in public health effects.

The water quality of the groundwater proposed for development in the Westside Basin, however, would be of varying quality from the existing water supply from the SFWD drinking water system. Table 40 compares water quality of the existing SFWD water supply (average values), quality of groundwater from the Westside Basin, and Drinking Water Standards. Although the water quality of the groundwater would meet drinking water standards, the groundwater samples indicated that levels of total dissolved solids, calcium, magnesium, sodium, hardness and nitrate are at least twice the level typically measured in SFWD drinking water. These differences could result in discernible changes in taste of the water supply. However, in the cases where potable groundwater is connected to either the local or main distribution system, such as for the Elk Glen and Sunset District wells, the developed groundwater would be blended with SFWD drinking water to varying degrees which would obscure any discernible differences in taste, depending on the dilution. At the point of the highest ratio of groundwater to surface water, the estimated percentage of groundwater to SFWD drinking water would be about 22% at the point of injection at the 30-inch diameter water main on Traverse Drive from the Elk Glen Well site. For groundwater originating from the Francis Scott Key School site, the estimated percentage of groundwater to surface water would be a maximum of 2.2% at the point of injection to the 60-inch water main on 28th Avenue at Kirkham Street, north of the existing Sunset Reservoir. For groundwater originating from the West Sunset Playground site, the estimated percentage of groundwater to surface water would be a maximum of 6.3% at the point of injection to the 60-inch water main on 30th Avenue at Rivera Street.[2] It should be noted that the design of the existing distribution system would not restrict conveyance of the groundwater to any particular area in the City.

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[2] Pezzetti, Tonianne, Hydrogeologist, CH2M Hill, Memorandum to Joyce Hsiao, Orion Environmental Associates, March 10, 1995.

Under long-term implementation of the GWMP, it is presumed that in addition to the Westside Basin, other groundwater basins may be considered for potable groundwater development. No public health effects would be anticipated for potable groundwater development in the other basins, assuming that the SFWD would use a similar approach to field investigation, regular monitoring and water quality testing, and on-site treatment as necessary, as proposed for the Elk Glen and Sunset District wells in the Westside Basin. Other long-term strategies in the GWMP relating to protection of groundwater quality, such as prevention of saltwater intrusion (Strategy 1A) and reducing the risk of future groundwater contamination through wellhead protection (Strategy 1B), would allow future potable groundwater development in the Westside and other basins. For further discussion on groundwater quality, see Section V.B.2, GWMP Impacts on Groundwater and Surface Water Resources, pp. 385 to 400. Final decisions regarding potable use of groundwater from other basins would be subject to additional environmental review.

Non-potable Groundwater

Goal 5 of the GWMP is to "maximize groundwater use," which would include various non-potable uses of groundwater. Long-term strategy 5B, "capture groundwater produced by dewatering operations," more specifically addresses potential non-potable uses of groundwater. Non-potable uses of groundwater could include irrigation of large landscaped areas (such as parks, golf courses, and athletic fields), toilet flushing and cooling in commercial areas, firefighting, and decorative fountains. Since the major irrigation users in the City are designated to receive recycled water as their non-potable water source, the potential non-potable groundwater users would be the large buildings in the Downtown Basin or firefighting through augmentation of the AWSS (discussed below). Any groundwater source developed for non-potable uses would be tested to ensure it is of suitable quality to for the designated use. Since any non-potable water source would be required to be labeled as such, public exposure would be minimal, if any. Testing the water quality for suitability with designated non-potable use and appropriate signage at the water source would minimize any potential public health or water quality impacts.

No public health or water quality impacts would be expected at the Powell Street BART Station, since the proposed project would consist only of re-locating the dewatering discharge from the sewer system to the AWSS. There would be no change in public exposure or change in rate of pumping at the BART Station. However, once the groundwater is injected into the AWSS system and blended with the AWSS water supply, there would be limited public exposure of the

water during fire fighting situations (primarily through contact with aerosol spray). Table 41 presents water quality data collected from the existing well at this site and compares it to representative water quality data for the AWSS water supply. Data from the Twin Peaks uncovered reservoir are used to represent water quality of the AWSS, since this reservoir is a supply source for the AWSS. The available data indicate that the AWSS water is generally within drinking water standards for the parameters measured, even though the water is not intended for potable uses. The quality of the groundwater discharge from the BART station well is also generally within drinking water standards for the parameters measured.[3] Since the proposed discharge to the AWSS would be for non-potable uses, the representative sample indicates that the water quality would be suitable for use in the AWSS.

[3] The water quality analysis was not intended to determine compliance with Drinking Water Standards, but rather to determine general water quality for major constituents. Drinking Water Standards are used only as a basis for comparison. Therefore, not all constituents regulated under the Drinking Water Standards were analyzed, and some of the analytical detection limits (arsenic and selenium) were too high to determine if levels were less than the standard. For example, the arsenic concentration in the Powell Street BART Station well was measured at <0.2 mg/L, but the Drinking Water Standard is 0.05 mg/L; at the level of accuracy of the detection level of 0.2 mg/L, it cannot be determined if the actual value is greater or less than 0.05 mg/L.

TABLE 41: AUXILIARY WATER SUPPLY SYSTEM WATER QUALITY (all units mg/L unless otherwise noted)

Parameter	Twin Peaks Reservoir /1/	Powell Street BART Station Well /2/	SFWD Drinking Water /3/	Drinking Water Standards /4/
Total Dissolved Solids	0.1	480	61	500 (S)
Specific Conductance, umho/cm	no data	880	101	900 (S)
pH, units	8.8	7.1	8.6	6.5-8.5
Total Coliform/5/	no data	<2	0.7	5% of samples positive (P)
Turbidity, NTU	0.7	<1	0.2	5 (S)
Dissolved Oxygen	9.58	no data	no data	no standard
Odor Threshold, units	no data	<1	<1	3 (S)
Calcium	no data	35.7	24	no standard
Magnesium	no data	43.5	10	no standard
Sodium	no data	108	9.1	no standard
Chloride	12	95	12.9	250 (S)
Hardness, as $CaCO_3$	65	264	33	no standard
Nitrate	0.041	7.7	0.46	45 (P)
Arsenic	no data	<0.2	0.001	0.05 (P)
Barium	no data	0.05	0.01	1.0 (P)
Cadmium	0.00027	<0.01	<0.001	0.005 (P)
Chromium	0.00254	0.02	<0.001	0.05 (P)
Copper	0.0032	<0.001	<0.001	1.0 (S)
Iron	0.155	<0.05	0.112	0.3 (S)
Lead	0.0035	<0.001	<0.001	0.015 (P)
Manganese	0.035	<0.01	0.009	0.05 (S)
Mercury	<.00025	<0.0002	<0.001	0.002 (P)
Nickel	0.00185	no data	0.002	0.1 (P)
Selenium	<.0022	<0.2	<0.002	0.05 (P)
Silver	no data	<0.01	<0.001	0.1 (P)
Zinc	0.0117	no data	<0.005	5.0 (S)

/1/ Twin Peaks Reservoir data collected April 1992 are used to represent the quality of AWSS, since it is one of the AWSS supply sources. Data shown are average values for the entire reservoir.

/2/ Powell Street BART Station dewatering well sampled on 12/9/93. Discharge proposed to be injected to AWSS.

/3/ SFWD drinking water data are from San Francisco Water Department 1994 Annual Water Quality Report, average values. Not all parameters shown. About 85% from Hetch Hetchy, 15% from local watersheds.

/4/ Drinking Water Standards include primary standards, noted with (P), also known as maximum contaminant levels, which are legally enforceable under the Safe Drinking Water Act. Lead standard shown is the federal action level, which is non-enforceable health-based guidance number. Secondary standards, noted with (S), are aesthetic standards and are not enforceable. Source: California Department of Health Services, Division of Drinking Water, November 1994..

/5/ Total coliform at the Powell Street BART Station well is measured in MPN/100 ml, which is a measure of the bacteria colonies; these values are from one-time sampling events and cannot be compared to the Drinking Water Standard. The Drinking Water Standard for total coliform, applicable to the SFWD drinking water, is measured in percentage of samples with positive readings for the presence of total coliform bacteria. No more than 5% of the number of samples collected during any month can be positive for total coliform, with a minimum of 40 samples required per month.

MPN = Most Probable Number; NTU = Nephelometric Turbidity Unit; umho/cm = micromho per centimeter

SOURCE: Orion Environmental Associates, 1995.

B.4 PUBLIC SERVICES AND UTILITIES

Introduction

The following impact analysis is organized by topic. Public services and utility impacts associated with the GWMP are evaluated on a program-level basis only, because they relate to overall system operation and construction in general. Refer to Section V.B.12, Energy, pp. 433 to 444, for discussion of energy utility needs associated with the GWMP.

Water Supply System

Under the proposed GWMP, treated groundwater could be incorporated into the City's potable water supply in the following ways: delivered directly from the well to an individual user, delivered from the well to the local distribution system, or delivered from the well to the main distribution system. The issue of the suitability of groundwater to meet public health and water quality standards for drinking water is addressed in Section V.B.3, Public Health and Water Quality, pp. 401 to 407.

In general, the GWMP proposes that groundwater would be blended with the City's imported surface water supply before delivery to the user (either through the local or main distribution system) in order to provide a uniform quality of water to City customers, with one category of exceptions. The exception would be for individual potable groundwater users, such as schools or large retail/commercial complexes, where groundwater would be extracted, treated and delivered directly to the user without blending; however, at this time, there are no users identified in this category. Potable groundwater from the Elk Glen Well and the new wells proposed in the Sunset District (GWMP Activities 5A1 and 5A2) would be injected into the City's main water supply distribution system for blending prior to distribution to customers.

No additional potable water storage reservoirs are proposed as part of the GWMP; groundwater would either be injected to the City's main or local water distribution system or to individual users. There could be a few discrete extensions in the existing water distribution system, where connections to any proposed groundwater production well would be installed. During construction of wells, treatment facilities (such as chlorination stations) and pipelines, there would be no interruption of water service to City customers. However, during the transition period when the groundwater supply system and/or blending is being tested before coming on-line, there may be short-term, localized disruption of water service, limited to a few hours in the immediate area where the pipe connections would be made. Development of this local drinking

water supply would increase the overall reliability of the potable water system due to the decreased dependence on the imported Hetch Hetchy water which could be disrupted by earthquake.

Fire Protection - Auxiliary Water Supply System (AWSS)

Implementation of the GWMP Activity 5B1, adding groundwater to the AWSS from the Powell Street BART dewatering system, would augment the AWSS water supply. During periods of non-use, the AWSS requires an average of 225 acre-feet per year of water to compensate for normal pipeline leakage and to maintain adequate pressure within the system. Addition of about 150 acre-feet per year of dewatering water would reduce the demand of the AWSS on other water supply sources and would help maintain the pressure of the system.

The connection between the Powell Street BART dewatering system and the AWSS system would be made in such a way that no (even temporary) disruption in AWSS service would be necessary during construction and connection.

Implementation of GWMP Long-Term Strategy 4A, "Evaluate use of groundwater as an emergency reserve," could eventually augment the fire protection provided by the AWSS with groundwater supply. GWMP Short-term Activity 4A1 proposes that the feasibility of development of large capacity standby wells be studied. Development of large capacity stand-by wells would improve the City's ability to respond to local emergencies. This would provide additional emergency water within the City that would not have to be transported or conveyed to the City. The City's imported water system has major transmission lines that cross earthquake faults before they reach the City and which are thus vulnerable to damage during an earthquake. An additional in-City supply would improve the fire protection system's reliability.

Wastewater and Stormwater System

Implementation of the GWMP Activity 5B1, connection of Powell Street BART dewatering system to the AWSS would cause dewatering water which is currently discharged to the wastewater/stormwater system to be diverted to the AWSS. This would slightly diminish the flow in the wastewater/stormwater system, thereby diminishing slightly the demand upon the wastewater/stormwater infrastructure. The volume of this reduced flow would be too low to have any affect on the treatment processes at the Southeast WPCP.

Installation of GWMP pipelines associated with connecting production wells to the water distribution system could result in short-term, localized disruption of existing wastewater/stormwater pipelines during construction in the event of accidental breakage. However, due to the shallow depth of excavation for the water pipes (less than 5 feet), this would generally not be anticipated.

B.5 GEOLOGY, SOILS, AND SEISMICITY

Introduction

The following impact analysis is organized by topic. All geologic, soil and seismic potential impacts are first evaluated on a program-level basis because they relate to construction and/or operation of all GWMP near-term facilities. Where site-specific information is available, it is presented. While the impact analysis below also provides a project-level analysis by identifying the general geotechnical impacts that could occur at all or some facility sites, more detailed project-level analysis would occur at each site as part of detailed geotechnical studies that would need to be completed prior to construction of all proposed facilities.

Ground Subsidence

Groundwater extraction could potentially result in ground subsidence. Subsidence is the vertical downward movement of the land surface. There are two general types of subsidence: (1) rapid subsidence caused by undermining or failure of the underlying strata; and (2) slow subsidence caused by consolidation of underlying strata. Rapid subsidence often occurs in areas where there are abandoned mines or aging infrastructure, or where limestone is the near-surface shallow bedrock. Water moving through these limestone features can cause caverns to form; when the roofs of these caverns collapse, a sinkhole forms. These types of features are not present in San Francisco. Slow subsidence, typically caused by consolidation of underlying clay and peat layers, occurs in areas where soil stresses increase due to removal of groundwater from the small pore spaces within the clay or peat. An example of this slow subsidence is the areal subsidence that has occurred in the Santa Clara and San Joaquin valleys as a result of excessive groundwater pumping. It is this slow, areal subsidence that is assessed through the modeling conducted during development of the GWMP.

The SFWD conducted modeling to estimate the range of subsidence that could occur in the Westside and Lobos basins, should these basins be developed.[1] The Westside and Lobos basins were selected because they were determined to have the highest potential for groundwater development. It should be noted that there are no historical records of subsidence in these basins, despite known groundwater extraction.

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[1] CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan, Technical Memorandum 11, Subsidence Modeling of Westside and Lobos Basins*, March 30, 1994.

For modeling purposes, both basins were assumed to consist of a single, controlled, confined aquifer with multiple clay layers (even though these basins are considered to be unconfined to semi-confined aquifers). The area was divided into five subareas: Golden Gate Park area, Sunset area, Lake Merced north area, Lake Merced south area, and Lobos Basin. The modeling effort used conservative assumptions for clay properties and pumping scenarios that would generate the most subsidence. The modeling results indicated that in the Sunset Area, the maximum subsidence would be between 0.3 and 0.6 feet, based on pumping rates of 500 gallons per minute (800 ac-ft/yr) and 1,000 gallons per minute (1,600 ac-ft/yr), respectively, assuming constant pumping for five years.

In both cases, the model results indicated that subsidence would occur in the first 61 days following start-up of pumping. Based on the saltwater intrusion modeling,[2] the proposed maximum combined pumping rate for the Sunset District wells would be about 600 gallons per minute (1,000 ac-ft/yr). If this maximum pumping rate is used, it can therefore be assumed, based on the model results, that the maximum subsidence in the Sunset Area would be about 0.4 feet (4 to 5 inches). Any subsidence, if it were to occur, would be gradual and diffuse throughout the area, and would not be noticeable at any one location.

Although subsidence modeling indicated that some degree of subsidence could occur in the Sunset area following increased pumping in existing wells or installation and operation of new wells, the overall impact of any subsidence would be considered low for the following reasons: (1) there are no historical records or evidence of subsidence in this area despite a history of known groundwater extraction prior to 1934; (2) pumping rates at the new wells would initially be lower than the estimated optimal rates in order to conduct verification of saltwater intrusion modeling and would not be increased to the optimal rates unless indicated to be safe by the modeling results; and (3) subsidence effects, if any, would be gradual, uniform and spread out throughout a wide area. Additional investigation and future modeling are recommended once additional site-specific data are available to confirm and update the modeling results (see Chapter VII, Mitigation Measure E-9).

Construction-Related Erosion Hazards at All Facilities

Construction of pipelines and well facilities under the GWMP would be subject to erosion hazards similar to those described for the RWMP (p. 300).

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[2] CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan, Technical Memorandum 14, Saltwater Intrusion Model*, May 12, 1995.

Seismic Hazards at All Facilities

Well and pipeline facilities that would be developed under the GWMP would subject to the same seismic hazards as those identified for RWMP facilities (pp. 301 to 303), and they include seismic shaking, soil lurching, soil liquefaction, soil densification, and soil subsidence. These seismic hazards would primarily affect pipelines and pipeline supports. Mitigation measures incorporated into the project, such as site-specific geotechnical investigations, would minimize seismic hazards (see Chapter VII, Mitigation Measures E-1 and E-2).

Geotechnical and Soil Engineering Constraints at All Facilities

Well and pipeline facilities under the GWMP would be subject to the similar geotechnical and soils constraints that are identified for RWMP facilities (pp. 303 to 306), and they include differential settlement along pipelines and at well-related structures, corrosion of pipelines, and settlement of soils if ponding occurs in soils with poor drainage characteristics. Mitigation measures incorporated into the project, such as site-specific geotechnical investigations, would minimize geotechnical and soils constraints (see Chapter VII, Mitigation Measures E-1, E-3 and E-4).

B.6 HAZARDOUS MATERIALS

Introduction

The following impact analysis is organized by issue, according to the various methods of potential exposure to hazardous materials associated with construction and operation of the GWMP. In most cases, the impacts are similar to those discussed under the RWMP. General, program-level impacts applicable are described first, followed by site-specific information, where appropriate, is provided on individual project sites under each issue area.

Exposure to Subsurface Contaminated Materials During Construction

Construction of GWMP facilities would have similar effects with regard to hazardous materials as the RWMP facilities. Excavation or other earthmoving associated with construction activities can result in the exposure of construction workers and the surrounding community to hazardous substances at sites where hazardous materials have historically been improperly handled, stored or discarded and resulted in soil or groundwater contamination. See Section V.A.6, Hazardous Materials (p. 307), for further discussion of general impacts of excavation in areas which may have potential hazardous materials contamination. See the same section, p. 308, for a discussion of the impacts associated with encountering unanticipated hazardous materials and the potential for encountering geologic materials which could potentially contain naturally-occurring asbestos. Contingency plans for encountering hazardous materials during construction and site safety plans to protect public health would be required for all sites (see Chapter VII, Mitigation Measure F-4). For GWMP facilities involving groundwater development, prior to any well installation, preliminary investigations would be conducted as part of the wellhead protection program. This would likely screen out sites with potential to encounter hazardous materials, and therefore, it is unlikely that hazardous materials would be encountered during well installation.

Production Wells

Construction of a typical production well, similar to those proposed at the Elk Glen site and in the Sunset District (GWMP Activities 5A1 and 5A2), would require excavation of about 230 cubic yards of soil for the chlorination facility and the well (see Table 11, p. 107). A review of current and previous land uses and a record search of regulatory agency lists was conducted to determine the potential to encounter hazardous materials during construction at any of the proposed production well sites (see Table 19, p. 207).

The site history review indicated that at the Elk Glen Well site, Francis Scott Key School site, and the West Sunset Playground site, there would be low potential to encounter hazardous materials during construction. At all of these sites, there are no current or previous land uses associated with hazardous materials handling, and there are no nearby known or suspected contaminated sites.

Implementation of the proposed Wellhead Protection Program (Activity 1B1) as part of the installation procedures for the proposed Sunset District wells as well as the city-wide groundwater monitoring program would minimize potential impacts of identified sources of hazardous materials to groundwater quality (see Section V.B.2, GWMP Impacts on Groundwater and Surface Water Resources, pp. 385 to 400).

Well Pipelines

Installation of any pipelines associated with proposed groundwater development under the GWMP would require excavation and typically, cut-and-cover construction. As described above, excavation or earthmoving activities can result in the exposure of hazardous materials in soils or groundwater. For example, the proposed pipelines to connect the proposed Sunset District production wells to the Sunset Reservoir would be installed in open trenches, generally within roadway rights-of-way, that would be excavated to a maximum depth of 5 feet. Due to the extent of development in the City and range of previous land uses, there would be a potential to encounter contaminated materials in the soils, particularly where the trenching would occur close to known contaminated sites. However, as part of the wellhead protection program for any groundwater development project, potential sources of hazardous materials would be identified in the vicinity of the proposed well and pipeline, and sites/pipeline alignments with known or suspected hazardous materials contamination would likely be eliminated from consideration. For the short-term GWMP projects, there are no listed sites with known or suspected contamination along any of the proposed pipeline routes from the Sunset District wells to the Sunset Reservoir or from the Elk Glen Well to the SFWD water main, and it is unlikely that hazardous materials would be encountered.

Powell Street BART Station Dewatering Reuse

The Powell Street BART station well is located in an area that was historically industrial and commercial land uses. There are four sites within one-quarter mile that have some record of spill or leaks of hazardous waste, and 36 listed sites within a one-half mile radius. However, the

water quality of discharge from the BART Station well indicates that the nearby recorded spill sites do not appear to be affecting the water quality of the dewatering discharge, although this does not mean it could not occur in the future. Periodic monitoring of groundwater quality from the dewatering facility would be recommended to assure that hazardous materials from off-site sources are not migrating towards the well (see Chapter VII, Mitigation Measure F-18).

The proposed facilities to re-route the dewatering discharge at the Powell Street BART Station from the sewer system to the auxiliary water supply system (AWSS) would not involve any excavation, but only construction and installation of new pumping and piping. Therefore, despite the known presence of hazardous materials in the vicinity of this site, it is unlikely that project implementation would result in exposure of hazardous materials contamination.

Operation of Production Wells

The wellhead protection program proposed as part of the GWMP (Activity 1B1) would institute a program to locate and consider potential sources of groundwater contamination from hazardous materials prior to approval of well construction and installation. In addition, the wellhead protection program would include a groundwater quality sampling program. Implementation of a wellhead protection program would reduce the potential for hazardous materials, which may be present in the soil or groundwater, to enter into the City's usable water supply. See Section V.B.2, Groundwater and Surface Water Resources (p. 385).

At the Powell Street BART Station, the re-routing of the dewatering discharge (Activity 5B1) would not be expected to change the current groundwater flow patterns, because the rate of pumpage would remain unchanged. Therefore, this would result in no change in the potential presence of hazardous materials in the soils or groundwater.

Operational Use of Hazardous Materials Use

The proposed groundwater extraction at the Elk Glen Well site and the Sunset District well sites would require construction of on-site chlorination stations to disinfect the groundwater prior to injection to the potable water distribution system. The chemical proposed for disinfection would be liquid sodium hypochlorite stored in polyethylene aboveground storage tanks with a capacity of about 6,650 gallons. A combination safety shower and eyewash would be located on each level of the chlorination station, since sodium hypochlorite is caustic and can be an irritant if improperly handled.

The presence of a caustic chemical at the Elk Glen Well site or either of the Sunset District well sites could pose a potential public health concern, since these sites are all accessible to the public. In particular, the Francis Scott Key School site is within the playground area of a school, where children regularly play. However, the chlorination facilities would be totally enclosed, as shown in Figure 29, p. 95, and partially below grade. Access to the chlorination facilities at all sites would be restricted with a locked fence, and safety signage would be attached to the fence to ensure public safety (see Chapter VII, Mitigation Measure F-17).

B.7 TRANSPORTATION AND CIRCULATION

Introduction

The following impact analysis is organized by impact topic with the impacts associated with each specific site or type of facility listed under the topic. The analysis focuses on construction impacts of proposed projects. No traffic impacts would result from operation of facilities proposed under the GWMP.

Construction-Related Trip Generation

Trip generation for construction associated with the Groundwater Master Plan projects is summarized below. This information is based on the construction scenario details presented in Chapter III, Project Description (pp. 105 to 109).

Elk Glen Well, Sunset District Wells, and Powell Street BART Station Dewatering Reuse

Vehicle trips generated at the Elk Glen and Sunset District wells would primarily consist of construction worker trips, and truck movements related to deliveries, soil excavation, and hauling. It is expected that approximately six construction workers would be required at each site, resulting in approximately 15 daily construction trip ends per site. Trucks would account for less than 10 daily trips at each well site. Fewer trips would be associated with the Powell Street BART Station dewatering facilities since excavation requirements would be less than well sites. Construction related to these projects would occur for a maximum of eight weeks.

Well Pipelines

The proposed well pipeline routes are presented in Figure 30, p. 98. The traffic generated by installation of the proposed well pipelines would consist of worker trips, trucks hauling materials to and from the site, and equipment traffic (including delivery of pipe). The number of workers at any one site would vary substantially depending upon the type of construction activity and project. Based on estimates of manpower per task and the experience of similar construction projects, there would be approximately 6 to 12 workers per crew on an average day.

The approximate trench size to accommodate the transmission and distribution pipelines would be approximately two and one-half feet wide and five feet deep. It is assumed approximately 50 percent of excavated trench soil would be hauled off-site (and 50 percent would be re-used),

and approximately 25 percent of the trench volume would be replaced with imported backfill. Cut-and-cover construction activities would be expected to proceed at an average rate of 50 to 100 feet per day.

Based on the estimated amount of material that would be excavated and filled along the pipeline segments, plus estimates of daily materials delivery and construction workers, up to 30 daily worker vehicle trips ends, and approximately ten daily truck trip ends (five truck loads) would occur. This would amount to up to 12 worker vehicle trips and approximately one truck trip during each of the peak hours.

Construction-Related Vehicle Trips

Elk Glen Well, Sunset District Wells, and Powell Street BART Station Dewatering Reuse

Construction associated with the production well/chlorination systems at the Elk Glen and Sunset District Wells, related well pipelines, and Powell dewatering facilities would result in a temporary increase in construction vehicle trips associated with arrival and departure of construction workers and transport of soil and materials to and from the construction sites. Thus, temporary off-site transportation impacts on City roadways would result from construction workers and truck movements to and from the sites. Construction of the proposed wells would require up to eight weeks. Primary and secondary thoroughfares (including 19th Avenue and Sunset Boulevard) would be used as haul routes to the extent possible. It should be noted that the specific haul routes would be designated after consultation with the City Department of Parking and Traffic and with Caltrans.

The amount of traffic generated by construction activities would not be substantial relative to background traffic conditions on the above thoroughfares. The effect of project-generated trips would be felt most on the two-lane local roadways serving the construction sites and pipeline alignments, including Kirkham Street, Moraga Street, Quintara Street, Rivera Street, and 39th Avenue.

Impacts of construction-related traffic would include short-term and intermittent lessening of roadway capacities due to slower movements and larger turning radii of construction trucks compared to passenger vehicles. Lane blockage due to queued trucks, if it were to occur, would temporarily reduce the roadway capacity of the affected streets. MUNI and SamTrans transit lines could be affected by truck movements.

Any truck traffic occurring during the hours of 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. would coincide with peak hour traffic and could impede traffic flow. Blockage during times of peak traffic flow would have greater potential to create conflicts than during non-peak hours because of the greater numbers of vehicles on the streets during the peak hour that would have to maneuver around the queued trucks. Prohibiting traffic during the a.m. and p.m. peak periods would minimize disruption of the general traffic flow on affected roadways during the a.m. and p.m. peak hours.

Should construction occur on other developments in the area during the project construction period, construction truck traffic would be expected to increase further, and traffic congestion and transit delays could be more extensive than described above. Nevertheless, the contribution to such cumulative traffic from this aspect of the project would be very small and of a limited duration.

Mitigation measures are identified to reduce the effect of construction-generated traffic impacts (see Chapter VII, Mitigation Measures G-1 to G-8). These include the preparation of a Transportation Management Plan that would be approved by the City to establish specific construction details, including the provision for restriction of truck traffic during the a.m. and p.m. peak periods; other mitigation measures include requiring the project construction contractor to coordinate with the construction contractor(s) for any concurrent nearby projects that could arise.

Construction-Related Roadway Disruptions

Well Pipelines

The well projects would also involve installation of transmission and distribution pipelines in and across streets. The location of the proposed pipelines within the roadways would be dependent on existing utilities under the roadway, and would be identified during the design phase of the project. The analysis provided in this EIR defines the curb-to-curb width of the street and subtracts a 12-foot-wide construction zone. Table 42 presents pipeline installation effects on roads along the alignment of the well pipelines.

Existing transportation and circulation patterns in the vicinity of the proposed pipeline alignments would be temporarily disrupted by construction activities and heavy equipment use. Impacts related to this project component would include direct disruption of traffic flows and

TABLE 42: PIPELINE INSTALLATION EFFECTS ON ROADS ALONG ALIGNMENT OF SUNSET DISTRICT WELL PIPELINES

Pipeline Within Road	Pipeline Crosses Road	Roadway Disruptions /a/	Transit Disruptions /b/	Bicycle/Pedestrian Disruptions	Disruptions in Access to Adjacent Land Uses
Francis Scott Key School Pipeline					
Kirkham Street		Kirkham Street paved street width reduced to 38 feet. Two travel lanes may be maintained with potential for removal of parking on one side of roadway.		Temporary disruptions to bicycle and pedestrian movement along and across roadways. Pipeline extends along citywide bicycle route on Kirkham Street.	Residences, school
	42nd to 37th Avenues, Sunset Boulevard, and 36th to 28th Avenues	Intersection at Sunset Boulevard potentially partially blocked during construction. Other intersections partially or completely blocked during construction. Construction within Sunset Boulevard could adversely affect traffic flow on this thoroughfare.	Pipeline crosses MUNI Lines 16 AX and 29 (Motor Coaches) at Sunset Boulevard	Pipeline crosses citywide bicycle route at 34th Avenue, and pedestrian crosswalks at Sunset Boulevard.	
West Sunset Playground Pipeline					
Quintara Street		Quintara Street paved street width reduced to 38 feet. Two travel lanes may be maintained with removal of parking on one side of roadway.	Pipeline extends along MUNI Line 48 (Motor Coach)	Temporary disruptions to bicycle and pedestrian movement along and across roadways.	Residences, park
	40th Avenue	Intersection partially or completely blocked during construction.			
39th Avenue		39th Avenue paved street width reduced to 28 feet. Two travel lanes may be maintained with potential for removal of parking on one side of roadway. Parking may need to be removed on both sides of the roadway depending on alignment of pipeline within roadway.	Pipeline extends along MUNI Line 48 (Motor Coach)	Temporary disruptions to bicycle and pedestrian movement along and across roadways.	Residences

TABLE 42: PIPELINE INSTALLATION EFFECTS ON ROADS ALONG ALIGNMENT OF SUNSET DISTRICT WELL PIPELINES (Continued)

Pipeline Within Road	Pipeline Crosses Road	Roadway Disruptions /a/	Transit Disruptions /b/	Bicycle/Pedestrian Disruptions	Disruptions in Access to Adjacent Land Uses
Rivera Street		Rivera Street paved street width reduced to 38 feet. Two travel lanes may be maintained with potential for removal of parking on one side of roadway.	Pipeline extends along MUNI Line 48 (Motor Coach) between 39th Avenue and Sunset Boulevard	Temporary disruptions to bicycle and pedestrian movement along and across roadways. Pipeline crosses pedestrian crosswalks at Sunset Boulevard.	Residences
	39th to 37th Avenues, Sunset Boulevard, and 36th to 30th Avenues	Intersection at Sunset Boulevard potentially partially blocked during construction. Other intersections partially or completely blocked during construction. Construction within Sunset Boulevard could adversely affect traffic flow on this thoroughfare.	Pipeline crosses MUNI Lines 29 (Motor Coach) at Sunset Boulevard, and Line 66 (Motor Coach) at 30th Avenue	Pipeline crosses citywide bicycle route at 34th Avenue, and pedestrian crosswalks at Sunset Boulevard.	

/a/ Assumes 12-foot-wide construction zone in roadways.
/b/ See Table 21, p. 215, for additional information on transit lines.

SOURCE: Environmental Science Associates, 1995

street operations. Lane blockages or street closures during pipeline installation would result in a reduction in travel lanes and curb parking, and could result in the need for traffic re-routing. Public transit routes, and pedestrian and bicycle traffic would be disrupted during construction. In addition, access to businesses and residences would be disrupted.

Pipeline installation within roadways would proceed at an average rate of 50 to 100 feet per day; thus identified impacts would be brief at any one location along the pipeline alignment. Special trenching techniques (i.e., jack-and-bore) would be utilized at major intersections (e.g., at Sunset Boulevard) to prevent complete blocking of these locations during construction. Mitigation measures are identified to reduce the effect of these impacts (see Chapter VII, Mitigation Measures G-1, G-2, G-7 and G-8). These include the provision for construction on major roadways to be conducted during the off-peak traffic periods; the use of flaggers, cones and barricades to control traffic flow; advanced notification to the public and emergency service providers regarding location and scheduling of construction work; and maintaining transit service through temporary transit re-routing.

B.8 AIR QUALITY AND ODOR

Introduction

The following impact analysis is organized by project site because impacts associated with air quality are site-specific and would occur on a project-level basis only. No program level air quality impacts would result from implementation of the GWMP. All short-term projects identified in the GWMP are analyzed on a project-level basis. Any future projects that arise from studies recommended by the GWMP (e.g., in-lieu recharge) would need to evaluate potential air quality effects on a project-level basis prior to their implementation.

Construction-Related Dust and Truck/Equipment Exhaust Emissions - General

Construction activities associated with implementation of the Groundwater Master Plan would generate dust (which includes the respirable fraction known as PM_{10}) and equipment exhaust emissions. The same types of impacts for construction-related dust, equipment exhaust, and odor that are described for facility and pipeline construction under the Recycled Water Master Plan (pp. 332 to 333) would also apply to the Groundwater Master Plan. However, well construction would necessitate substantially less surface disturbance than recycled water facilities construction and therefore, the degree of impact associated with dust and exhaust emissions would be lower than for construction of the proposed recycled water system facilities.

Dust emissions generated during construction of monitoring wells, production/extraction wells, or dewatering facilities would not be expected to exceed state or federal PM_{10} standards given the limited extent of surface disturbance and material excavated. Production wells would involve the most earthwork, an area of 640 square feet and excavation/handling of about 184 cubic yards of material. Equipment exhaust emissions would also not be expected to exceed state or federal standards because of the limited extent of construction required for facility development. Cut-and-cover pipeline construction, however, would have the potential to exceed state (but not federal) PM_{10} standards where residences are located in very close proximity (165 feet or less) to the construction area.

Construction-Related Dust and Truck/Equipment Exhaust Emissions at Specific Sites

Elk Glen and Sunset District Wells. Recreational uses associated with Golden Gate Park are located in the vicinity of the Elk Glen Well. All potential well locations in the Sunset District are located adjacent to or near residential, school or recreational uses. Such uses would be

considered sensitive receptors. As indicated above, neither dust nor exhaust emissions would not be expected to exceed State or Federal standards. Due to the proximity of sensitive receptors, however, dust control measures should be implemented to minimize the nuisance of effects of dust. Dust control measures included as part of the project include continuous dust suppression using non-potable water, covering of soil stockpiles, frequent street cleaning, covering of haul trucks, and use of soil binders (see Chapter VII, Mitigation Measure H-1).

Powell Street BART Station Dewatering Reuse. Proposed facilities at the Powell Street BART Station would be located completely underground and would involve only minor equipment operation and little or no excavation.

Well Pipelines. Construction of well pipelines would have similar construction-related impacts as those described for the RWMP transmission and distribution pipelines (p. 333). In general, pipeline construction would pose a high potential for violation of the State standard (but not the federal standard) for PM_{10}. These high PM_{10} levels can be attributed primarily to the close proximity of the residences to the pipeline construction area. Residences located downwind and within 165 feet of the pipeline construction area could be subject to PM_{10} levels that exceed the State standard. However, it should be noted that elevated PM_{10} levels at any particular residence would occur primarily when excavation/ backfilling activities occur directly in front of that particular residence, which would be less than one week. Cut-and-cover construction would progress at a rate of 50 to 200 feet per day and various construction activities could occur in the vicinity of one location along the construction route for one to two weeks.

Operational Air Quality Emissions and Odor Potential

The Groundwater Master Plan would result in the development of groundwater extraction wells, monitoring wells, injection wells, transmission lines, and dewatering facilities. Since these facilities would be located underground and would be enclosed and since groundwater is odorless, no measurable increase in air emissions or odors would be anticipated.

B.9 NOISE AND VIBRATION

Introduction

The following impact analysis is organized by project site because impacts associated with noise are site-specific and would occur on a project-level basis only. No program level noise impacts would result from implementation of the GWMP. All short-term projects identified in the GWMP are analyzed on a project-level basis. Any future projects that arise from studies recommended by the GWMP (e.g., in-lieu recharge) would need to be evaluated for potential noise impacts on a project-level basis prior to their implementation.

Construction-Related Noise and Vibration

The same types of impacts for construction-related noise and vibration that are described for facility and pipeline construction under the Recycled Water Master Plan (pp. 341 to 357) would also apply to the Groundwater Master Plan. However, well construction would cause substantially less surface disturbance than recycled water facilities construction and therefore, the potential for noise and vibration effects would be lower than for construction of the proposed recycled water system facilities.

Construction of proposed monitoring wells would require minimal equipment for one or two days. Construction of production/extraction and some types of injection wells would entail more excavation, resulting in longer construction duration and heavier equipment types than would be associated with monitoring wells. Construction of production/extraction and injection wells would take approximately four weeks to complete and would involve the use of heavy construction equipment (pavement cutter, drill rig, etc.) for drilling of the borehole, removal of excavated material, and construction of facilities. Construction of wells would require use of some types of equipment listed on Table 33 (p. 342; pavement cutters and drill rigs would generate noise levels similar to those listed for pavers and generators) except that pile drivers would not be required. While such noise levels (when mitigated as proposed, see Chapter VII, Mitigation Measure I-1) would comply with the City's 80-dBA noise limit (as discussed above under Section IV.I, Noise and Vibration Setting, p. 232), the effect of such noise levels on adjacent or nearby sensitive noise receptors at each well site is discussed below.

Elk Glen Well

There are no sensitive noise receptors located within the vicinity of the Elk Glen Well site, and therefore, no adverse construction-related noise or vibration impacts on sensitive receptors would occur.

Sunset District Wells

Nearby sensitive receptors that could be affected by project-related construction noise would include residential and school uses. In particular, proposed facilities would be located on school playgrounds one of the two sites, within 80 to 100 feet of school classrooms. Residential uses would be located across the street from all three sites generally 100 feet or more away. Based on noise levels listed in Table 33 (p. 342, construction-related noise increases would reach approximately 70 to 92 dBA at school buildings and residences without feasible noise controls (assuming 100-foot separation can be maintained). Assuming feasible noise controls are implemented, these noise levels could be reduced to approximately 69 to 74 dBA at the exteriors of the closest residences and classrooms. Interior noise levels of 64 dBA with windows open and 54 dBA with the windows closed could be achieved in residences and classrooms. At these levels, windows may need to be closed at times in order to minimize speech interference effects.

Powell Street BART Station Dewatering Reuse

Construction of dewatering facilities at the Powell Street BART station would not be expected to affect any sensitive receptors since there are no sensitive receptors in the vicinity. Construction would occur in the vicinity of the sump which is located at the end of the lower platform at the BART station (no public access allowed on this section of the platform). It is anticipated that construction of the proposed facilities would occur during daytime working hours. No noise disturbance to BART patrons or workers using the lower platform would be anticipated since no heavy equipment would be required to construct this portion of the facility. Construction would also require excavating a trench at the surface above the BART station, which would require use of heavy equipment. Temporary noise increases due to operation of heavy equipment are not expected to disrupt operation of nearby commercial uses.

Well Pipelines

Specific pipeline routes are identified in Section IV.G, Transportation and Circulation (p. 209). Sensitive receptors located along these pipeline routes include residential uses and recreational

uses where pipelines would be constructed in or adjacent to parks, and schools. Construction of well pipelines would result in noise impacts similar to those described for the RWMP transmission and distribution lines (pp. 352, 353 and 357). Cut-and-cover construction would progress at a rate of 50 to 200 feet per day, and maximum noise levels directly in front of an individual residence would last for approximately one to two days. However, construction activities could occur in the vicinity of any one location along the pipeline route for one to two weeks. Due to the proximity of noise sources to receptors along residential streets, noise levels could periodically interfere with speech within residences during this period.

Operational Noise - General

Facilities that would be developed under the Groundwater Master Plan would be a new source of noise. Proposed facilities would include monitoring wells, production/extraction wells, injection wells, transmission lines, and dewatering facilities. Monitoring wells, transmission lines, and dewatering facilities would be enclosed and underground and would have no sources of noise. However, production/extraction and some types of injection wells would have two types of noise sources: pumps and exhaust fans. In general, production/extraction wells would have one vertical turbine pump but pump size would depend on the well capacity and other factors. Chlorination stations would be located adjacent to the extraction stations and they would include a roof exhaust fan and wall louvers. Noise generation potential of pumps and fans at production wells would depend on their size and design, but generally pump noise could range between 60 and 70 dBA at 50 feet. Since roof exhaust fans would not be motorized, fan noise is not expected to be noticeable.

Elk Glen Well

Operation of pumps at this well could generate noise levels of 60 to 70 dBA at 50 feet. Depending on the design of the enclosure, these noise levels could be reduced by 15 or 40 dBA. The higher attenuation is achieved when the pump enclosure has masonry walls and a metal roof, while the lower attenuation is provided by an enclosure with walls but no roof. If pumps are located underground, much lower noise levels would be generated. Although such noise levels and projected vibration levels would not affect any sensitive noise receptors (since none are located in proximity to this site), park users could be subject to a noticeable noise increase depending on the design of the well enclosure. Measures included as part of the project (see Chapter VII, Mitigation Measures I-13 and I-14) would limit the potential increase in ambient

noise levels to 5 dBA (which would be noticeable), but also emphasize designing enclosures to maximize attenuation so as to maintain existing ambient noise levels to the extent feasible.

Sunset District Wells

Operation of pumps at these wells could generate noise levels of 60 to 70 dBA at 50 feet or 55 to 65 dBA at 100 feet, but actual noise levels would depend on the pump size and operation characteristics. In addition, actual noise levels would depend on the noise attenuation effectiveness of the proposed enclosure and whether pumps would be located underground. Since wall louvers and a roof exhaust fan are proposed for ventilation and enclosures with wall louvers have been measured to attenuate noise levels by 15 to 20 dBA, operational pump noise levels could be maintained at or below 50 dBA at adjacent residences (assuming a minimum 100-foot separation is maintained). Such noise levels could be noticeable during the nighttime hours if pumps were operated at night and wall louvers were located facing sensitive receptors. Measures included as part of the project (see Chapter VII, Mitigation Measures I-13 and I-14) would limit the potential increase in ambient noise levels to 5 dBA (which would be noticeable), but also emphasize designing enclosures to maximize attenuation so as to maintain existing ambient noise levels to the extent feasible.

B.10 BIOLOGICAL RESOURCES

Introduction

This section addresses the GWMP activities that could affect biological resources: well and pipeline construction at the Elk Glen site in Golden Gate Park, the proposed In-Lieu Recharge project, and overall groundwater management. Only a general discussion of the potential types of impacts that could result from the In-Lieu Recharge project is presented at this time, since only the project concept has been outlined and there are no specific facility or operation design plans yet developed. Additional environmental review will be conducted for this project in the future, as appropriate.

Groundwater Wells and Pipelines

No biological resources occur at the two Sunset District well sites or the Powell Street BART Station, except for a line of mature Monterey pine trees which line the northern end of the parking lot at the West Sunset Playground site. These trees would be avoided during construction of the well and would not be affected by the proposed project. Installation of the Sunset District wells, the Powell Street BART Station dewatering facilities, and associated pipelines would have no effect on biological resources; these pipelines would be placed within paved areas or in City streets.

Construction of the Elk Glen Well project would temporarily disturb an area of approximately 1,800 to 2,000 square feet in the vicinity of Elk Glen Lake. The completed facility would occupy an approximately 640-square-foot area, causing the loss of 640 square feet of grass or other landscaped material. The 120-foot pipeline connecting the Elk Glen Well to the main water distribution line in Transverse Drive would be constructed to the degree possible within existing paved and soft-surface paths, to minimize effects to biological resources. During construction, temporary fencing would be installed between the site and the lake, in order to prevent construction impacts to lakeside vegetation. The area disturbed during construction of the well and pipeline would be re-landscaped after construction completion. SFWD would coordinate with the Recreation and Park Department regarding appropriate species and landscape design (see Chapter VII, Mitigation Measure J-10).

In-Lieu Recharge

An indirect effect of implementation of the GWMP could be that in-lieu recharge could cause an increase in Lake Merced water levels, as discussed in Section V.B.2, Groundwater and Surface Water Resources (pp. 385 to 400). An increase in the water level in Lake Merced could decrease the width of the shallow water zone around the perimeter of the lake, thereby decreasing the amount of freshwater marsh tule habitat.[1] Tule marsh provides habitat for many species, including songbirds, red-legged frogs, and western pond turtles. However, an increase in lake water level would also increase the habitat for fish in the lake. More detailed modeling to determine effects of groundwater levels on Lake Merced levels would be carried out under the GWMP.

Determinations regarding lake level goals would need to take these conflicting biological resource concerns, as well as other beneficial uses of the lake (including recreation) into consideration.

Groundwater Management

Goal 3 of the GWMP is to "protect and conserve related water resources," which would apply primarily to the lakes in the Westside Basin, and Lobos Creek in the Lobos Basin. Protection of lakes and streams associated with groundwater systems would indirectly provide additional protection of associated aquatic habitats.

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[1] GeoResource Consultants, Inc., *Lake Merced Water Resource Planning Study*, for San Francisco Water Department, May 1993.

B.11 CULTURAL RESOURCES

Introduction

The following impact analysis is organized by project site because impacts associated with cultural resources are site-specific and would occur on a project-level basis only. No program-level impacts on cultural resources would result from implementation of the GWMP. All short-term projects identified in the GWMP are analyzed on a project-level basis. Any future projects that arise from studies recommended by the GWMP (e.g., in-lieu recharge) would need to be evaluated for potential cultural resources impacts on a project-level basis prior to their implementation.

Groundwater Master Plans Sites

As described in Section IV.K, Cultural Resources (p. 243), no recorded subsurface cultural resources of prehistoric/protohistoric age are known to exist within the Elk Glen Well and Sunset District Well sites, but unrecorded archaeological sites from this era may exist.[1] The presence of prehistoric deposits discovered in San Francisco during recent archaeological work suggests that other, unrecorded similar archaeological deposits may exist in various places throughout San Francisco. There is no evidence that historical resources occur within or adjacent to the well sites.[2] However, there would be a potential for unrecorded buried archaeological or historical resources to be encountered during construction of all GWMP facilities including wells, underground dewatering facilities at the Powell BART Station, and pipelines. To minimize potential damage to artifacts, Mitigation Measure K-2 in Chapter VII outlines procedures that the contractor must follow in the event any cultural resources are encountered.

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1 Archeo-Tec, *In-house Archival Cultural Resource Overview Study of Selected Sites Associated with the San Francisco Recycled Water and Groundwater Master Plan EIRs*, letter report to Environmental Science Associates, April 7, 1995.

2 ibid.

B.12 ENERGY AND NATURAL RESOURCES

Energy Demand - General

Construction of near-term projects (including wells and associated pipelines) under the GWMP would consume energy in the form of electricity and fossil fuels. Construction-related energy demand would be similar to the demand associated with construction of facilities under the RWMP (see Section V.A.12, Energy and Natural Resources, p. 376).

Most of the short-term activities specified in the GWMP would not require energy. Energy demand would be associated with construction and operation of some near-term projects under the GWMP. The following near-term projects would require low amounts of energy for development/implementation, and portable generators would be used to supply needed energy: 1C1, developing and implementing a groundwater monitoring program; 3A1, conducting additional field investigation at Lake Merced; and 5D1, developing and implementing a study of the Lobos Basin. Under 4A2, designing, installing and operating large capacity standby wells, wells are designed to operate on a short-term basis and pumps would only be operated for a few hours during maintenance; these production wells would only be operated during emergencies which would be on a short-term basis. Under 5C1, conducting conjunctive use in the Lobos Basin, the City would supply surface water to the southern portion of the Westside Basin during wet years, and pumping energy requirements would be offset since pumps in the Westside Basin would not be operated. During dry years, energy demand required to operate pumps in the southern portion of the Westside Basin when the City would not supply surface water would be the same as the existing energy demand. Under 5C2 and 5E2, the activities are not defined sufficiently to evaluate energy requirements.[1]

The only remaining short-term activities in the GWMP that would produce new energy demand are the Elk Glen Well (5A1), Sunset District Well (5A2), and Powell Street Dewatering Facility (5B1). Groundwater well pumps would be the primary source of increased energy demand associated with these groundwater facilities, and energy demands are described below. Implementation of the GWMP would result in an overall decrease in energy demand associated with pumping groundwater, assuming recycled water replaces all current irrigation pumping demand and less groundwater is pumped (which would occur with RWMP implementation). However, changes in energy demand at each facility would vary as described below under each facility.

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[1] Ben Romero, CH2M Hill, Telephone Communication and Memorandum, October 5, 1995.

All extraction, injection, and monitoring well sites are expected to be located in developed areas where there are existing electrical facilities. Therefore, no extension of new facilities would be required. The extent of facility upgrading that could be required at each facility site is currently unknown and would depend on electrical requirements associated with each facility.

Elk Glen Well

The Elk Glen Well is an existing well used for irrigation of Golden Gate Park. While there would be a short-term increase in energy demand associated with construction of the proposed well improvements, the operational energy associated with pumping groundwater at the project well would be approximately 1.4 million kWh per year.[2]

Sunset District Wells

Sunset District Wells would be new wells and there would be a short-term increase in energy demand associated with construction of the proposed wells, and a long-term increase in energy demand associated with their operation (approximately 1.5 million kWh per year).[3] The amount of energy associated with wells would depend on the pump size, design and operating characteristics.

Powell Street BART Station Dewatering Reuse

There would be a short-term increase in energy demand associated with construction of the proposed dewatering facilities at the Powell Street BART station dewatering system. There would be an increase energy demand associated with operation of one additional pump (approximately 0.2 million kWh per year).[4]

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2 This estimate is derived from estimated annual operating costs of $187,000 less $17,000 in testing costs, and assumes electricity costs of $0.12/kWh (CH2M Hill, *Groundwater Master Plan Technical Memoranda Nos. 12a and 13,* August 8, 1994 and July 25, 1994).

3 This estimate is derived from estimated annual operating costs of $195,000 less $17,000 in testing costs, and assumes electricity costs of $0.12/kWh (CH2M Hill, *Groundwater Master Plan Technical Memoranda Nos. 12b and 13,* August 8, 1994 and July 25, 1994).

4 This estimate is derived from estimated annual operating costs of $23,200 and assumes electricity costs of $0.12/kWh (CH2M Hill, *Groundwater Master Plan Technical Memoranda Nos. 12c and 13,* June 27, 1994 and July 25, 1994).

WATER SUPPLY EFFECTS AND GROWTH INDUCEMENT POTENTIAL OF THE RWMP AND GWMP

CHAPTER VI

WATER SUPPLY EFFECTS AND GROWTH INDUCEMENT POTENTIAL OF THE RWMP AND GWMP

A. INTRODUCTION

Implementation of both the RWMP and the GWMP would supplement water supply for the City. The RWMP would provide a new supply of non-potable water that would replace the current use of potable water for non-potable uses and, in effect, would "save" potable water. The GWMP provides a framework for projects to produce both additional potable and non-potable water supply from the City's groundwater resources.

This section discusses the cumulative effect of both Master Plans on the City's overall water supply. It reviews the contribution (in terms of supplemental water supply) that implementation of these two plans would make to the City's water supply in light of the City's existing supply, its future supply, and the existing and projected future water demand.

Based on the analysis of how these two plans could affect the City's water supply and its ability to meet projected water demand, this section then discusses the growth inducement potential of the RWMP and GWMP, as required by CEQA (Guidelines Section 15126[g]).

B. SFWD SERVICE AREA AND CUSTOMERS

The San Francisco Water Department (SFWD) provides water to customers within the City and County of San Francisco and throughout the South Bay area. The SFWD water service area is shown in Figure 61. Table 43 lists SFWD's water customers. Customers within the City and County of San Francisco boundaries are retail customers referred to as "In-City" customers. Included in the retail customers category are a few customers which lie outside the City boundaries. These "outside SF" retail customers, shown on Table 43, include customers such as the United States Navy, the San Francisco International Airport, and the town of Sunol.

SFWD provides water deliveries on a wholesale basis to 30 customers which are collectively known as the Bay Area Water Users Association (BAWUA, also referred to as the wholesale customers or suburban customers).[1] These 30 customers are located in the Bay Area counties of

[1] City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993, pp. II-10 and II-15.

SOURCE: San Francisco Water Department

SF RWMP / GWMP Program EIR ■

Figure 61
San Francisco Water Department
Service Area

TABLE 43: SFWD - CUSTOMERS

Retail Customers

In-City Customers

- Water customers within San Francisco (i.e., residents, businesses, industry, schools, and parks)

Other Outside San Francisco

- United States Navy
- Town of Sunol
- San Francisco International Airport
- Groveland Community Services District
- Lawrence Livermore Laboratory (Department of Energy)
- Castlewood Country Club
- Filoli Center

Wholesale Customers (Bay Area Water Users Association)

Alameda County

- Alameda County Water District (1)
- City of Hayward (15)

Santa Clara County

- City of Milpitas (20)
- City of Mountain View (21)
- City of Palo Alto (23)
- City of San Jose (27)
- City of Santa Clara (29)
- City of Sunnyvale (32)
- Purissima Hills County Water District (24)
- Stanford (31)

San Mateo County

- City of Brisbane Water Department (3)
- City of Burlingame (4)
- City of Daly City (11)
- Town of Hillsborough (16)
- City of Menlo Park (18)
- City of Millbrae (19)
- City of Redwood City (25)
- City of San Bruno (26)
- Belmont County Water District (2)
- California Water Service Company (5), (6), (7), (8)
- Coastside County Water District (9)
- Cordilleras Mutual Water Association (10)
- East Palo Alto Water District (12)
- Estero Municipal Improvement District (13)
- Guadalupe Valley Municipal Improvement District (14)
- Los Trancos County Water District (17)
- North Coast County Water District (22)
- Palomar Park County Water District #3 (28)
- Skyline County Water District (30)
- Westborough County Water District (33)

SOURCE: City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993.

San Mateo, Santa Clara and Alameda. These wholesale customers are listed in Table 43 and are cross-referenced by number with Figure 61. The wholesale customers, in turn, sell water on a retail basis to water customers in their service areas.

About two-thirds of the wholesale customers are entirely dependent on SFWD for 100 percent of their water supply; the remaining one-third obtains a portion of their water from other supply sources, discussed below. SFWD has generally supplied about 65 percent of the total water demand for its wholesale customers. A population of over 2.3 million people within the counties of San Francisco, San Mateo, Santa Clara, Alameda and Tuolumne rely entirely or in part on water supplied by SFWD.[2]

C. WATER SUPPLY

SFWD SYSTEM

Overview

SFWD manages a complex water supply system that serves customers throughout the south San Francisco Bay region as well as the City and County of San Francisco. Section II.D (p. 18) provides a brief description of the SFWD water supply system and Figure 6 shows a schematic of the system. The system obtains water primarily from two sources: the Tuolumne River via the Hetch Hetchy system in the Sierra Nevada mountains; and local runoff into reservoirs in two Bay Area watersheds - the Calaveras and San Antonio reservoirs in Alameda County and the Crystal Springs, San Andreas and Pilarcitos reservoirs in San Mateo County.

The City's Hetch Hetchy Water and Power Department manages the system of reservoirs, hydroelectric generation and transmission facilities, and water transmission facilities from Hetch Hetchy Valley west to the Alameda East Portal near Sunol. SFWD manages the supply system from this point west and is responsible for distribution of Hetch Hetchy system water and water from the local watershed reservoirs to its customers.

System Yield

The firm water supply delivery yield of the existing SFWD system is estimated to be 242 million gallons per day (mgd) (271,040 ac-ft/yr).[3] This is less than current demand (see Section below,

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2 ibid. p II-10.
3 ibid. p II-3.

p. 442). The Firm Delivery Yield[4] represents the amount of water delivery that can be provided on a sustained basis from the City's Hetch Hetchy system in combination with its local Bay Area reservoirs. The hydrologic period used to define the Firm Delivery Yield is the recent drought of 1987 through 1992.

In normal years, approximately 80 percent of the potable water supplied by SFWD to its customers is provided by the Hetchy Hetchy system; the remainder is provided by the local watershed reservoir component of the system.[5] Local Bay Area watershed runoff and groundwater provide about 20 percent of supply on average during normal years, but only a small percent during drought periods (approximately 6 percent during the recent drought period 1987 through 1992).[6] Local area water supply available from the City's watershed reservoirs depends on the amount of rainfall and the City's ability to manage watershed runoff. Based on yearly runoff, the utilization of water from the local watersheds has varied from 2 mgd to approximately 104 mgd. Table 44 and Figure 62 show the amount of water supplied by local runoff between 1986 and 1992.

Supply Commitments/Contracts

SFWD has contractual obligations to supply up to 184 mgd to its suburban wholesale customers in accordance with the 1984 Settlement Agreement and Master Water Sales Agreement (Master Agreement). The remaining supply yield of the SFWD system is available to SFWD's retail customers. In 1984, the average available capacity of the system was estimated to be 285 mgd. Thus, at the time the Master Agreement was established, the City's share of the supply was estimated at 101 mgd. SFWD retains the right to develop additional water from the Hetch Hetchy and/or local systems. Any additional water supply would be available to its retail customers; the City contends that the wholesale customers do not have a right to additional water supplies beyond the contractual guarantee of 184 mgd.[7]

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4 ibid. p. II-46. Firm Delivery Yield is the amount of water deliveries that can be sustained without shortage during all historical hydrologic sequences (1921 to 1992). To determine the Firm Delivery Yield for the Hetch Hetchy System, system operation is simulated using increasing water demand assumptions until the system can no longer meet the demand. Demand can not be met when there is no longer reservoir storage or runoff available to fully meet water demand.

5 ibid. p. II-23.

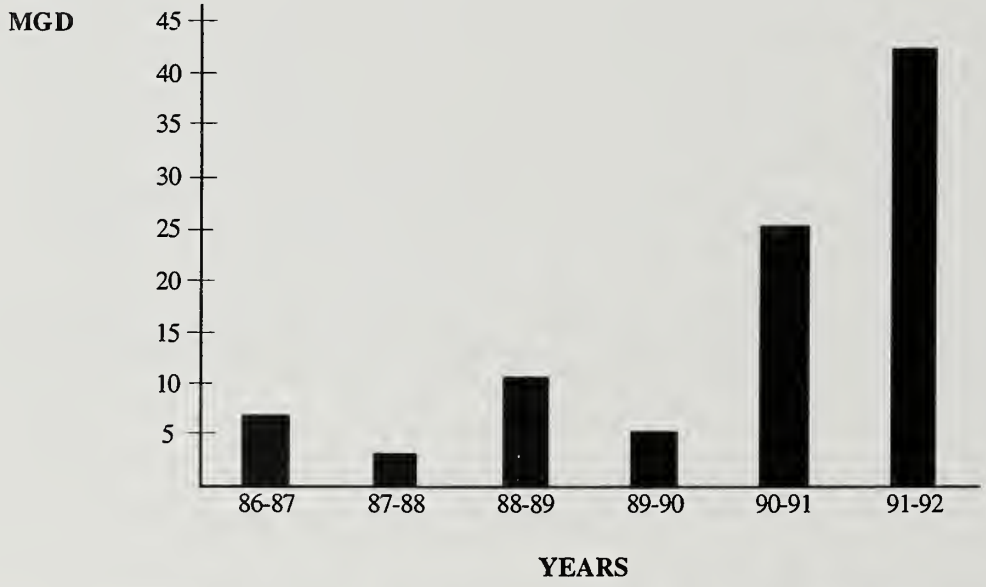
6 ibid. p. II-23.

7 The wholesale customers contend that the City has an obligation to provide additional water beyond the 184 mgd supply guarantee. The City disputed this claim in the litigation leading to the 1984 contract, which reserved the issue without deciding it (J. Milstein, Deputy City Attorney, personal communication, January 1996).

TABLE 44: LOCAL BAY AREA RUNOFF UTILIZATION 1986 TO 1992

Year (July through June)	Amount	
	mgd	ac-ft/yr
1986-87	7	7,800
1987-88	2	2,200
1988-89	12	13,400
1989-90	4	4,500
1990-91	24	26,900
1991-92	42	47,000

SOURCE: City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993.



San Francisco RWMP/GWMP / 910641

SOURCE: Data from Table 44; graph prepared by Environmental Science Associates, 1995

Figure 62
Local Bay Area
Runoff Utilization 1986-1992

During drought periods neither the City nor the wholesale customers receive their full entitlement as established in the Master Agreement. During a drought the City can declare a water shortage emergency pursuant to California Water Code Section 350, et. seq. It can institute rationing for its retail customers and require the wholesale customers to ration water based upon a percentage of past usage, as measured against water then available in the SFWD system.

OTHER SUPPLY SOURCES

San Francisco

San Francisco obtains a small supplemental water supply from groundwater, primarily for non-potable use. Groundwater use in San Francisco has averaged approximately 4 mgd. This includes 1 mgd at Golden Gate Park, 1 mgd at Lake Merced, and 2 mgd at the Presidio.[8,9]

Suburban Communities

As noted above, approximately two-thirds of SFWD's 30 wholesale customers rely on SFWD for 100 percent of their supply.[10] The other one-third of these customers obtain some portion of their water from other sources including the State Water Project (SWP) managed by the California Department of Water Resources (DWR), the Central Valley Project (CVP) managed by the U.S. Bureau of Reclamation, local groundwater and surface water resources, and recycled water.

Most of the San Mateo County communities depend fully on SFWD for water supply. In Santa Clara County, the Santa Clara Valley Water District (SCVWD) manages a network of surface water reservoirs and the groundwater basin for its water supply. SCVWD imports SWP and CVP water which augment its local surface water and groundwater supplies and conducts artificial groundwater recharge with the imported water.[11] The Alameda County Water District manages its groundwater resources for water supply and augments these with imported SWP and local supplies from Alameda Creek. CVP water is delivered to the South Bay through the

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8 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993, p II-50.

9 Water supply at the Presidio is provided by surface diversions from spring-fed Lobos Creek and is considered groundwater use.

10 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993, p II-50.

11 Department of Water Resources, *California Water Plan Update (Bulletin 160-93), Volume 2*. October 1994. p. 58.

San Felipe Project which became operational in 1987. SWP water is delivered to the area by the South Bay Aqueduct.

In the 1994 California Water Plan Update, DWR reports that within the South Bay planning subarea there are several recycling projects which provide approximately 33,000 acre feet of water for non-potable uses.[12] Additional water recycling programs and projects are in progress throughout the SFWD service area.

D. WATER DEMAND

Projected water demands for SFWD retail and wholesale customers are presented in the recently updated Urban Water Management Plan for the County and County of San Francisco.[13] These water demand projections are summarized here and portions of the Plan analysis are excerpted.

RETAIL CUSTOMERS

Water use within San Francisco is currently less than that experienced in the 1940s. Many factors have contributed to this reduction in water use including significant changes to the mix of industrial and commercial businesses and its associated water demand, and the general characteristics of water use by San Francisco water customers. In particular, the droughts of 1976-77 and 1987-92, and the conservation programs either voluntarily embraced by residents and businesses or mandated by San Francisco, have apparently affected water demands.

Total water use by the San Francisco retail customers is estimated to be currently 90 million gallons per day (mgd). Approximately 51 percent of this total is delivered to San Francisco residential customers. Non-residential water use accounts for approximately 40 percent of the demand with the system losses accounting for approximately 9 percent. Both absolute water consumption and the per capita use of water have declined in San Francisco.

In the 1970's gross per capita consumption ranged from 160 to 175 gpcd. At the end of the 1976-77 drought it reached a low of about 120 gpcd. It rebounded and stabilized through the 1980's at about 140 gpcd until the drought began in 1987. The current gross per capita consumption rate of water by San Francisco retail water customers is 119 gpcd.

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12 ibid. DWR's South Bay planning subarea includes San Francisco, San Mateo, Santa Clara, Alameda, and Contra Costa counties.

13 Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996.

Projected water use by San Francisco's retail customers has been estimated using San Francisco's water use models. These models have incorporated economic and demographic forecast data developed by ABAG which includes the projection population, housing units and employment in San Francisco. Also incorporated into the forecast models is the anticipated change in the water use within the residential and non-residential sectors due to conservation programs implemented within San Francisco. These programs are consistent with the *Memorandum of Understanding Regarding Urban Water Conservation in California*, which San Francisco signed in 1991. This document committed San Francisco to the evaluation and implementation of numerous long-term conservation measures which are referred to as Best Management Practices (BMPs).

Table 45 presents projected water demand for San Francisco retail customers, showing demand for in-city customers separate from other retail customers. Results of the water demand forecasts show that San Francisco's retail water demand will only slightly increase by the year 2010. Demands are projected to increase from approximately 90 mgd (1995) to approximately 92.5 mgd by the year 2010, an annual increase of 0.18 percent of the next 15 years. This projected increase in retail water demands is due to estimated growth in business and industry activity with a commensurate increase in water use. The increase in water use within these sectors is forecast to be partially offset by decreases in water use within the residential sectors.

The forecasted water demands of both the single-family and multi-family residential sectors are projected to be less than current demands. This circumstance occurs as a result of projections that 1) population density within housing units will decline in the future, and 2) market penetration of conservation measures within the residential sectors will increase as time progresses. Together, these two factors will lead to less water use by a slowly increasing population. An analysis of the anticipated effects of existing long-term conservation programs implemented by San Francisco indicates that without long-term conservation the retail water demand would be up to 10.2 mgd (11 percent) higher than current 1995 levels and would be 16.4 mgd (18 percent) higher by the year 2010.

WHOLESALE CUSTOMERS

Although San Francisco does not specifically perform water demand forecasting of the wholesale water demand, coordination and exchange of information occurs between San Francisco and the wholesale water customers. This coordination normally occurs through the San Francisco Bay Area Water users Association (BAWUA). The 30 customers that comprise BAWUA, and constitute SFWD's wholesale customers, have provided future water demand projections to the City.

TABLE 45: PROJECTED RETAIL CUSTOMER WATER DEMAND (mgd)

Entity	Year 1995	2000	2005	2010
In-City Customers				
Single-family Residential	17.7	17.6	17.1	16.8
Multi-family Residential	27.9	27.8	27.8	27.7
Non-residential	29.5	30.9	31.8	32.8
Other (Builders & Contractors, Docks & Shipping)	0.2	0.2	0.2	0.2
Sub-Total	75.3	76.5	76.9	77.5
Unaccounted-for Water (losses)	7.0	7.0	7.0	7.0
TOTAL	82.3	83.5	83.9	84.5
Other Retail Customers and HHWP Customers				
Other Retail Customers Served by Water Department	5	5	5	5
Groveland Community Services District	1	1	1	1
Lawrence Livermore Laboratory	1	1	1	1
Sub-Total	7	7	7	7
Conveyance Losses	1	1	1	1
TOTAL	8	8	8	8
Total Potable Water Demands Served by San Francisco	**90.3**	**91.3**	**91.9**	**92.5**
Water Demands Served with Non-potable Water				
Sunol Area/Castlewood	2	2	2	2
Golden Gate Park	1	1	1	1
Lake Merced Area	1	1	1	1
TOTAL	4	4	4	4
Other Water Demands within City Limits				
Presidio (Not anticipated to be served by City)	2	2	2	2

SOURCE: Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996.

The most recent projection of water demands for the wholesale water customers originates from information developed for and provided to the Federal Energy Regulatory Commission (FERC) for its proceeding concerning San Francisco and the New Don Pedro Project on the Tuolumne

River.[14] That information and certain revisions form the basis for projecting the wholesale water demands included in this report.

The total water demands of the wholesale water customers were developed by customer class and are shown in Table 46. Both the 1985 and 1990 values are historically observed deliveries while the 1995 through year 2010 values are demand projections. The 1990 water deliveries include the effects of the 1987 through 1992 drought and the programs responding to water shortages. The data shows that for the year 2010, water demands of the wholesale water customers (regardless of water source) will increase to approximately 297 mgd. This increase amounts to about a 16 percent increase over 1985 deliveries (approximately 13 percent when considering the offset of demand by reclamation).

TABLE 46: PROJECTED WHOLESALE WATER CUSTOMER TOTAL WATER DEMAND AND PER CAPITA RATE (mgd)/a/

	1985	1990	1995	2000	2005	2010	Change/b/
Customer Class Potable Demand (mgd)							
Residential	136.1	120.0	146.3	155.6	163.8	171.1	25.7%
Commercial	38.3	28.5	31.9	34.7	36.2	38.1	-0.5%
Industrial	39.8	28.0	30.6	35.8	38.0	39.8	0.0%
Other	41.2	33.7	36.9	37.2	38.5	40.1	-2.7%
Total Demand	255.4	210.2	245.7	263.3	276.5	289.1	13.2%
Reclaimed Water	0.0	0.5	3.9	6.2	7.2	8.1	16.0%
Total	255.4	210.4	249.6	269.5	283.7	297.2	
Population	1,360,800	1,455,400	1,545,000	1,603,000	1,657,000	1,694,000	24.5%
Per Capita Water Use (gpcd)							
Gross	188	144	159	164	167	171	-9.1%
Residential	100	82	95	97	99	101	1.0%

/a/ 1985 and 1990 values are historically observed deliveries while 1995 through 2010 values are projections.
/b/ Change since 1985.

SOURCE: Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996.

[14] City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210,* June 8, 1993.

Based on population projections made by the wholesale water customers, which BAWUA found to be very consistent with comparable Association of Bay Area Governments projections, the projection of population served by the wholesale water customers within the three-county area was made (Table 46). Table 46 depicts a projected increase in population within the areas served by the wholesale water customers of approximately 25 percent between 1985 and the year 2010. Compared to the projected growth in water demands, a decrease in gross per capita water usage is projected for the wholesale water customers in comparison to pre-drought conditions.

The virtually flat residential per capita usage infers conservation savings in the residential sector. This inference is made since growth in that sector is anticipated to occur in portions of the service areas that have land use and climate that are conducive to higher water use than the current overall-use associated with the current water customers.

The wholesale water customers rely on San Francisco and to some extent other supplemental sources of water supply to meet water demands. Although two-thirds of the wholesale water customers are entirely dependent on San Francisco for water, the other one-third of the customers are able to obtain some portion of their water from other sources. These additional sources include groundwater, local surface water, the Santa Clara Valley Water District (Santa Clara) and the State Water Project. In a few cases, reclaimed water is also an additional source of water supply. Table 47 lists the sources of supply available to the entire group of wholesale water customers, although not all the sources listed are available to each customer.

Comparing the total demands projected for the wholesale water customers (Table 46) with the other sources of water which are projected to be used by a number of those customers (Table 47), Table 48 depicts the wholesale water customer demand that will occur to San Francisco. As shown in Table 48, water use of SFWD water by its wholesale customers was 134.4 mgd in 1990 and is projected to increase about 17 percent to 157.7 mgd by fiscal year 1995-96. Over the next fifteen years, from 1995 to 2010, this demand is expected to increase about 18 percent to a total of 186.6 mgd. This represents an average annual increase of about 1.2 percent.

Several entities are projecting increasing reliance on supplies other than San Francisco to hold their San Francisco demands constant, or in some instances reduce their demands. If these other resources fail to materialize, then the group's water demands could be higher than projected. Section E., below, describes anticipated and potential deficits in water supply relative to demand for both the SFWD system and the other sources of supply serving the wholesale customers. The supply projections made by the wholesale water customers do not account for the variability in

TABLE 47: WHOLESALE WATER CUSTOMERS SUPPLIES OTHER THAN SFWD SUPPLY (mgd)

	DEMAND					
	Year					
	1985	1990	1995	2000	2005	2010
Santa Clara/a/	11.5	14.8	19.0	18.6	19.0	20.0
State Water Project/b/	8.7	8.5	21.8	28.7	28.7	28.7
Groundwater/c/	58.7	50.9	44.8	42.9	47.0	51.4
Surface Water/d/	1.6	1.7	2.4	2.4	2.4	2.4
Recycled Water/e/	0.0	0.5	3.9	6.2	7.2	8.1
TOTAL	80.5	76.4	91.9	98.9	104.5	110.7

/a/ Treated water deliveries only. Includes SWP and CVP imports.
/b/ Only water treated by Alameda County Water District.
/c/ Includes natural groundwater and SWP/CVP water recharged by ACWD and SCVWD.
/d/ Water not managed by SFWD.
/e/ Recycled water supplied by other existing or proposed projects but not including the SF RWMP.

SOURCE: Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996; and City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210,* June 8, 1993.

TABLE 48: SAN FRANCISCO WHOLESALE WATER CUSTOMER DEMAND (mgd)

	1985	1990	1995	2000	2005	2010
Total Wholesale Customer Demand	255.4	210.7	249.6	269.5	283.7	297.2
Other Supplies	80.5	76.4	91.9	98.9	104.5	110.7
San Francisco Wholesale Water Customer Demand	174.9	134.3	157.7	170.6	179.2	186.5

SOURCE: Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996.

water supply hydrology associated with each source, nor do they incorporate the potential impacts of recent or pending regulatory decisions such as the State Water Resources Control Board 1995 Water Quality Control Plan for the Bay-Delta estuary, which may significantly impact the availability of water from State Water Project and the federal Central Valley Project.[15]

TOTAL SFWD CUSTOMER WATER DEMAND

Demand Served By SFWD

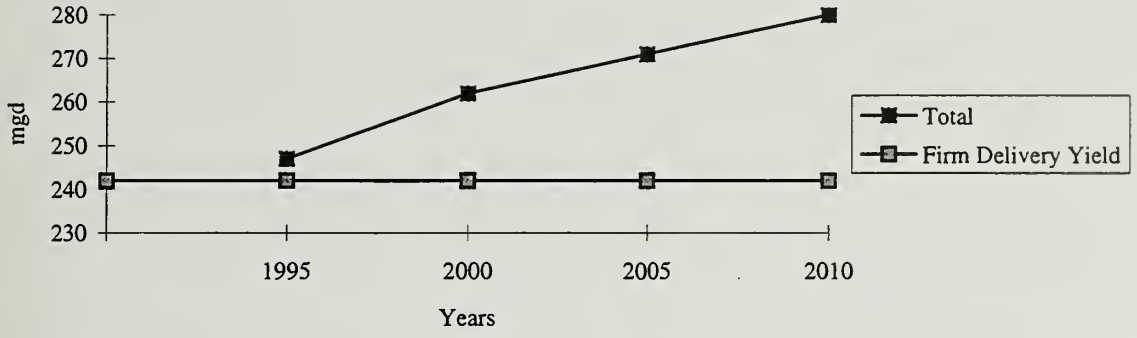
The total water demand affecting the City's Hetch Hetchy/local reservoir system is the combination of the projected requirements of the wholesale customers, shown in Table 48 (p. 447), and the SFWD's retail water demand, presented in Table 45 (p. 444). Table 49 combines the water demand projections for SFWD retail and wholesale customers to display the total amount of projected demand affecting the Hetch Hetchy/local reservoir system. Total projected demand on SFWD is graphed in Figure 63. Between 1995 and 2010, total demand on SFWD is projected to increase about 13 percent from 248 mgd to 279 mgd; this represents an average annual increase of 0.86 percent.

TABLE 49: TOTAL PROJECTED SFWD CUSTOMER WATER DEMAND SERVED BY SFWD (mgd)

	1995	2000	2005	2010
Retail Customers	90.3	91.3	91.9	92.5
Wholesale Customers	157.7	170.6	179.2	186.5
TOTAL	248.0	262.1	271.1	279.0
SFWD Firm Delivery Yield	242	242	242	242
Deficit	6	20.1	29.1	37
Percent Exceedence of Firm Delivery Yield	2.4%	8.3%	12.0%	15.3%

SOURCE: Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996; and, City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210,* June 8, 1993.

[15] City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210,* June 8, 1993.



San Francisco RWMP/GWMP / 910641

SOURCE: City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993.

Figure 63
Total Projected SFWD Customer Water Demand Served By SFWD

SFWD Customer Demand on All Sources of Supply

The combined projected water demand for all SFWD retail and wholesale customers on the SFWD supply system as well as on all other sources of supply serving the wholesale customers is shown on the top half of Table 50. The total regional demand is projected to increase about 15 percent from 339.9 mgd in 1995 to 389.7 mgd in the year 2010. This represents an average annual increase of 1 percent.

E. PROJECTED WATER SUPPLY DEFICITS

SFWD Supply

As shown on Table 49 and Figure 63, the total projected demand to be served by SFWD via the Hetch Hetchy/local reservoir system already exceeds the Firm Delivery Yield of 242 mgd in 1995 (see definition of Firm Delivery Yield on p. 439). When demand exceeds the firm yield of the supply source this does not mean that in a given year the demand can not be met, but that over the long-term this demand exceeds the sustainable yield of the source and this level of demand can not be met consistently; eventually if this level of demand persists, supply will fall short of demand and will have to be rationed. By the year 2010 the projected demand would exceed this Firm Delivery Yield by approximately 37 mgd or 15.3 percent.

TABLE 50: TOTAL PROJECTED DEMAND FOR SFWD RETAIL AND WHOLESALE CUSTOMERS AND PROJECTED DEFICITS IN SUPPLY (All Supply Sources)

	1995	2000	2005	2010
Demands (mgd)				
City Retail Customers	90.3	91.3	91.9	92.5
Wholesale Customers				
From SFWD	157.7	170.6	179.2	186.5
From Other Sources	91.9	98.9	104.5	110.7
Subtotal	249.6	269.5	283.7	297.2
Total	339.9	360.8	375.6	389.7
Firm Yield of Supplies (mgd)				
SFWD	242.0	242.0	242.0	242.0
Santa Clara	14.8	14.8	14.8	14.8
SWP	8.5	8.5	8.5	8.5
Ground Water	50.9	50.9	50.9	50.9
Surface Water	0.0	0.0	0.0	0.0
Recycled Water/a/	3.9	6.2	7.2	8.1
Total	320.1	322.4	323.4	324.3
Projected Deficit (mgd)	19.8	38.4	52.2	65.4
Projected Deficit (as % of Firm Yield)	6%	12%	16%	20%

/a/ This recycled water is provided by other project not including the SF RWMP.

SOURCE: City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993; and Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996.

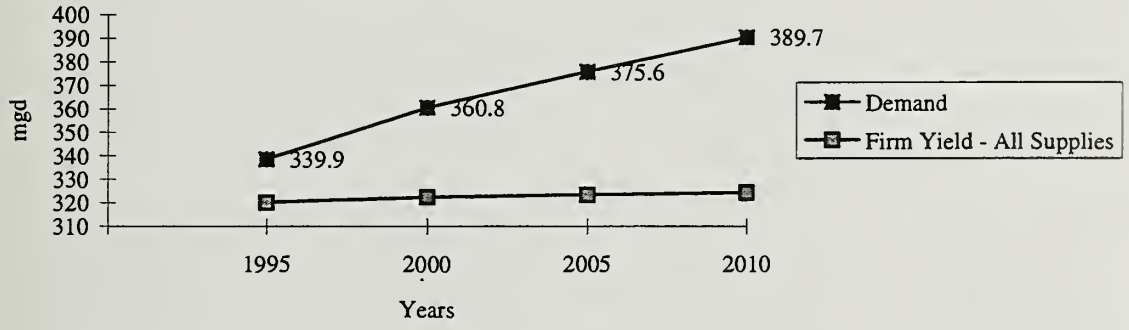
Because projected water demand exceeds the Firm Delivery Yield, water delivery reduction (rationing) will be required during drought periods. With current levels of water demands, these reductions are projected to occur greater than 10 percent of the time, sometimes for several years in sequence.[16] Analyses prepared by the City indicate that water rationing up to 30 percent of demand could be required in certain years under existing conditions for Hetch Hetchy operations. As water demand continues to increase, the frequency and duration of shortages will increase.[17]

16 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993.

17 ibid.

All Supply Sources

With respect to the larger, regional picture regarding the ability of current water supplies to meet projected future demand, the City compared the firm yield of both its supply and the other supply sources used by its wholesale customers against the projected total wholesale customer demand (Table 50). As shown in Table 50 and illustrated in Figure 64, a supply deficit of about 6 percent or about 19.8 mgd is projected for fiscal year 1995-96. Over the next fifteen years, this deficit is projected to increase to 65.4 mgd in the year 2010. This represents a shortfall of 20 percent between projected year 2010 demand and the estimated firm yield of all current supplies.



San Francisco RWMP/GWMP / 910641

SOURCE: City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993; and Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco*, March 1996.

Figure 64
Total Projected Demand for SFWD Retail on All Supply Sources and Wholesale Customers

In its 1994 California Water Plan Update, DWR reports that the South Bay Planning Subarea (including San Francisco, San Mateo, Santa Clara, Alameda, and Contra Costa counties) would experience water shortages of approximately 30,000 ac-ft/yr (26.8 mgd) in years of average precipitation.[18] During drought years this annual supply shortage would increase from 272,000 ac-ft/yr (242.9 mgd) in 1990 to 417,000 (372.3 mgd) in 2020. These projections assume the use of existing water supply facilities. With additional facilities and management programs, DWR reports that the South Bay Planning Subarea could meet average water year demand through 2020 and would experience drought year shortages of about 228,000 ac-ft/yr (203.6 mgd).

[18] Department of Water Resources, *California Water Plan Update (Bulletin 160-93), Volume 2*. October 1994, p. 59.

These projected deficits, for the SFWD service area and DWR's South Bay Planning Subarea, do not include the potential further reductions in water supply firm yield that could result from regulatory actions now in progress, including the State Water Resources Control Board's revision of Bay-Delta water quality and flow standards, the application of the Endangered Species Act to water supply operations (i.e., to provide Delta flows for the Delta smelt, winter-run chinook and steelhead trout), and Public Law 102-575, the Central Valley Project Improvement Act (CVPIA). DWR indicates that its water deficit projections are based on the existing Delta operating criteria established by SWRCB's Decision D-1485.[19] These criteria may be revised as a result of the several regulatory and legal actions noted above now in progress. The DWR report indicates that with criteria revisions to further protect Delta aquatic species, the water supply shortages would be understated.

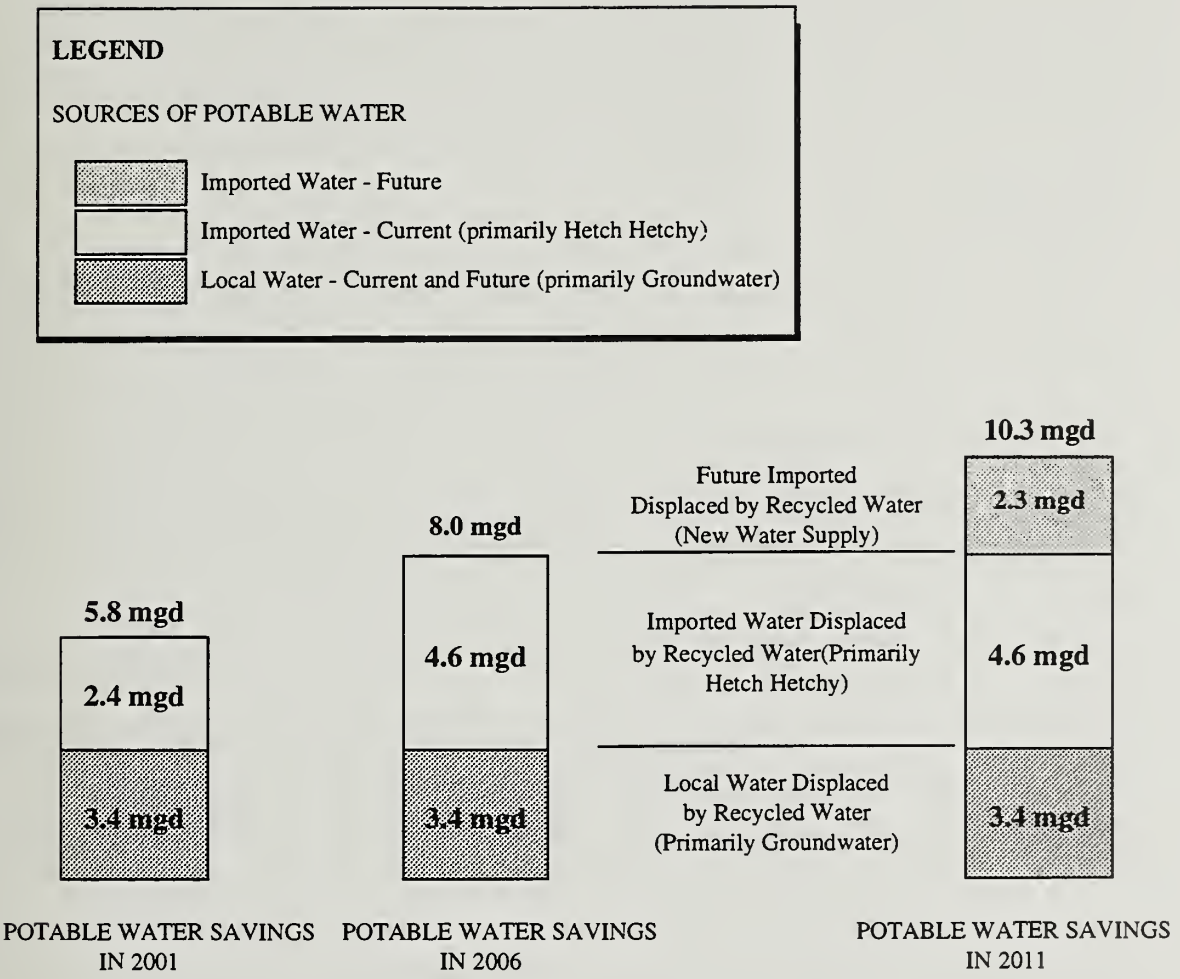
F. EFFECT OF RWMP AND GWMP ON WATER SUPPLY

RWMP

Under the RWMP, recycled water would replace the current use of potable water for various non-potable uses (primarily irrigation) and would be available for non-potable water uses to be developed in the future, avoiding the need to allocate additional imported potable water to these future uses. The potential potable water savings resulting from RWMP implementation are illustrated on Figure 65. With the recycled water system, potable water now used for existing non-potable uses could be saved at an average daily flow of 5.8 mgd by 2001 and 8 mgd by 2006. As shown on Figure 65, the potable water savings includes 3.4 mgd of groundwater now used for non-potable irrigation uses primarily at Golden Gate Park, the Lake Merced/Zoo area and the Presidio. As indicated in the GWMP, much of this groundwater is suitable for and proposed for potable use. The first phase of the RWMP would free up approximately 3,800 ac-ft/yr (3.4 mgd) of groundwater. The first phase would also free up 2.4 mgd or about 2,700 ac-ft/yr of imported Hetch-Hetchy water. With the second phase of the RWMP, another 2.3 mgd or 2,500 ac-ft/yr of imported Hetch Hetchy water would be saved.

By implementation of Phase 3 in the year 2011, recycled water would also serve new non-potable uses and save up to an additional 2.2 mgd or 2,500 AF/y of future imported water supply. The new, future non-potable uses consist primarily of new irrigation and toilet flushing uses

[19] Department of Water Resources, *California Water Plan Update (Bulletin 160-93), Volume 2.* October 1994, p. 59.


LEGEND
SOURCES OF POTABLE WATER
Imported Water - Future
Imported Water - Current (primarily Hetch Hetchy)
Local Water - Current and Future (primarily Groundwater)
5.8 mgd
2.4 mgd
3.4 mgd
8.0 mgd
4.6 mgd
3.4 mgd
10.3 mgd
Future Imported Displaced by Recycled Water (New Water Supply)
2.3 mgd
Imported Water Displaced by Recycled Water(Primarily Hetch Hetchy)
4.6 mgd
Local Water Displaced by Recycled Water (Primarily Groundwater)
3.4 mgd
POTABLE WATER SAVINGS IN 2001
POTABLE WATER SAVINGS IN 2006
POTABLE WATER SAVINGS IN 2011

San Francisco RWMP/GWMP / 910641

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

Figure 65
RWMP - Estimated Average Daily Potable Water Savings

created with the development of Mission Bay and Executive Park, and the redevelopment of Hunter's Point. By 2011, the total potential potable water saved would be 10.3 mgd.

GWMP

The GWMP provides a framework for the additional development and use of groundwater resources in the City. Groundwater resources may be either potable or non-potable, and thus further development and use of the groundwater could either contribute directly to the City's potable water supplies, or, like recycled water, use of non-potable groundwater could indirectly

"conserve" potable water. No specific estimate of the additional long-term water supply that might be available from the seven City groundwater basins can be made at this time due to the lack of sufficient hydrogeologic information. Many factors affect the development potential of each basin as described in the GWMP and in Section IV.B, Groundwater and Surface Water Resources (pp. 155 to 180).

In the near-term, the GWMP proposes increased production from the existing Elk Glen Well in Golden Gate Park and development of additional wells in the Sunset District (GWMP Activities 5A1 and 5A2, pp. 85 and 86). The groundwater in these areas is expected to be potable and thus, directly supplement the City's potable water supply. The total production possible from the westside basin has to be determined through more detailed monitoring and site-specific analysis but based on current data could range from approximately 1,000 afy to 1,800 afy (1.1 to 2.0 mgd).[20]

In addition, the GWMP proposes a near-term project to use the groundwater currently dewatered from the Powell Street BART Station by putting it into the local AWSS emergency water system (GWMP Activity 5B1). This project would use approximately 225 ac-ft/yr or 0.2 mgd of non-potable groundwater.[21] Therefore, in total, the specific wells projects plus the BART dewatering reuse project proposed at this time under the GWMP could make available up to about 1.8 mgd (2,025 ac-ft/yr) of potable water. These near-term projects may not yield quite that much, but for purposes of this analysis of supply and growth inducement potential a yield of 1.8 mgd is used.

It is possible that additional supplemental groundwater supplies may be developed under the GWMP beyond those near-term projects currently outlined. The potential amount cannot be estimated at this time. However, the GWMP could make additional contributions to the City's water supply as potable and/or non-potable groundwater resources are further developed.

RMWP and GWMP Contribution to Potable Supply

The cumulative contribution of the RWMP and GWMP to the City's water supply would be to increase available potable water supply by 7.6 mgd by the year 2000, by 9.8 mgd by the year 2006, and by 12.1 mgd with full buildout of the RWMP by the year 2011. This is shown in Table 51.

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[20] City and County of San Francisco, *San Francisco Groundwater Master Plan, Draft*, September 1995, p. 7-8 Table 7-1.

[21] ibid. p. 7-12 Table 7-2.

TABLE 51: CONTRIBUTION OF RWMP AND GWMP TO POTABLE WATER SUPPLY

	2000		2006		2011	
	mgd	ac-ft/yr	mgd	ac-ft/yr	mgd	ac-ft/yr
RWMP	5.8	6,500	8.0	9,000	10.3	11,500
GWMP/a/	1.8	2,025	1.8	2,025	1.8	2,025
TOTAL	7.6	8,525	9.8	11,025	12.1	13,525

/a/ Only a few near-term projects are proposed at this time under the GWMP. These specific projects could yield up to 1.8 mgd. The Master Plan establishes a framework for additional groundwater development projects. Additional groundwater development would increase the GWMP's contribution to potable water supply beyond that shown here. Any additional projects would undergo further environmental review and permitting, as appropriate.

SOURCE: Compiled by Environmental Science Associates from: City and County of San Francisco, *Recycled Water Master Plan*, July 1996; City and County of San Francisco, *Groundwater Master Plan, Draft*, July 1996.

The near-term contribution of the RWMP and GWMP to water supply of 7.6 mgd represents approximately 8.4 percent of the projected 1995 SFWD retail customer demand of 90.3 (Table 45, p. 444). With full buildout of the RWMP in the year 2010, the combined water supply contribution of the RWMP and GWMP would be approximately 12.1 mgd. This would represent approximately 13.1 percent of the projected SFWD retail customer water demand of 92.5 mgd in the year 2010.

With respect to total SFWD customer demand, retail and wholesale customers combined, the 7.6 mgd of saved potable water represents 3 percent of the 262 mgd demand in the year 2000 (see Table 49, p. 448). The maximum potable water savings of 12.1 mgd in the year 2010 represents 4.3 percent of the total projected SFWD customer demand. Finally, in comparison with the total water supply demands of SFWD retail and wholesale customers on SFWD and other supply sources (see Table 50, p. 450), the initial potable savings of 7.6 mgd represents 2.1 percent of total regional demand in the year 2000 and the maximum potable savings of 12.1 mgd represents 3.1 percent of the 2010 total regional demand.

G. GROWTH PROJECTIONS

San Francisco

Population projections for the City and County of San Francisco from 1990 through 2010 prepared by the Association of Bay Area Governments (ABAG) and the State Department of Finance (DOF) are shown on Table 52. The ABAG projects that population in the City will increase by about 40,700 over the next 15 years, from the 1995 population of 759,900 to 800,600 people.[22] This represents about a 5.3 percent total increase and an average annual growth rate of about 0.35 percent over the next 15 years. After the year 2015, the population is expected to decline slightly based on assumptions regarding the aging of the populace and an expected decline in household size.[23]

The Department of Finance projections (Table 52) indicate a similar but slightly slower growth rate, with an 8 percent population increase between 1990 and 2010, resulting in a population of 781,735 people.[24] This represents an average annual increase of about 0.4 percent. ABAG's 2010 population projection is higher by 18,865 people or about 2.4 percent.

TABLE 52: EXISTING AND PROJECTED POPULATION FOR THE CITY AND COUNTY OF SAN FRANCISCO

Source	1990	1995	2000	2005	2010	2015
ABAG '96	723,959	759,900	780,400	789,100	800,600	795,800
DOF	723,900	-	774,011	-	781,735	-

SOURCES: Association of Bay Area Governments (ABAG), *Projections '96 - Forecasts for the San Francisco Bay Area to the Year 2015*, December, 1995; California Department of Finance (DOF), *Projected Total Population of California Counties*, Report 93 P-3, May 1993.

22 Association of Bay Area Governments, *Projections 1996 - Forecasts for the San Francisco Bay Area to the Year 2015*, December 1995.

23 Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco*, March 1996.

24 State of California, Department of Finance, *Projected Total Population of California Counties, Report 93 P-3*, May 1993.

ABAG household projections for San Francisco are presented in the top portion of Table 53. Households are estimated to increase by about 27,616 or 9 percent between 1990 and 2010. ABAG analyses indicate that San Francisco ranks as the fourth most populous county in the Bay Area region. ABAG projects that San Francisco will retain a generally constant (declining slightly) relative position in terms of regional household and population share. In 1980 San Francisco had 15 percent of the regional households. By the year 2015, it is expected to have 12 percent.

TABLE 53: GROWTH PROJECTIONS FOR SAN FRANCISCO, SAN MATEO AND SANTA CLARA COUNTIES

	1990	1995	2000	2005	2010	2015
San Francisco County						
Population	723,959	759,900	780,400	789,100	800,600	795,800
Households	305,584	311,430	317,730	325,600	333,200	338,390
Person/Household	2.29	2.37	2.40	2.37	2.35	2.30
Total Jobs	566,640	534,610	567,920	600,130	623,100	638,670
San Mateo County						
Population	649,623	696,450	727,300	754,750	746,950	755,350
Households	241,914	247,300	255,910	264,020	268,740	237,970
Person/Household	2.64	2.77	2.79	2.81	2.74	2.72
Total Jobs	311,600	318,350	355,660	377,990	387,960	405,720
Santa Clara County/a/						
Population	1,430,964	1,539,300	1,635,850	1,696,650	1,739,400	1,763,450
Households	499,535	517,690	540,930	566,720	586,760	601,630
Person/Household	2.67	2.75	2.77	2.72	2.70	2.88
Total Jobs	823,760	799,710	853,040	909,130	955,700	989,490
Total Population	2,804,546	2,311,650	3,143,550	3,240,500	3,286,950	
Total Jobs	1,702,000	1,652,670	1,776,620	1,887,250	1,966,760	

/a/ Projections do not include Morgan Hill and Gilroy, except for County-wide average persons per household.

SOURCE: Association of Bay Area Governments, *Projections 1996- Forecasts for the San Francisco Bay Area to the Year 2015*, December 1995.

Table 53 also shows ABAG's job projections for total jobs within San Francisco. With respect to employment status, there was no net job growth between 1980 and 1986. There was some job growth between 1987 to 1990 but more jobs were lost between 1990 and 1993. ABAG estimates that a slow economic recovery has begun in San Francisco, but that it will take until 1999 before the County regains 1990 employment levels. Between 1995 and 2015, job demand in San Francisco County is expected to rise by 104,100 new jobs, or about 5,200 new jobs annually. With this level of job growth, San Francisco County would be fourth in the Bay Area in job creation. San Francisco's share of total regional jobs will continue to decline. In 1980, San Francisco had 22 percent of Bay Area jobs; this share is expected to decline to 16 percent by 2015. This decline in percentage of total Bay Area jobs does not indicate a net job loss but rather reflects a strengthening of the job decentralization trend.

ABAG's projections are based on an analysis of the City and County land use planning and development policies. ABAG indicates that the population and employment growth projected for San Francisco is consistent with the land use and development/redevelopment allowed under the San Francisco General Plan.[25] ABAG Projections-96 reports that the strong demand for housing is constrained by the high cost of new development and neighborhood opposition.[26] It further states that the San Francisco Planning Department did not identify any specific infrastructure constraints to future development. Specific projects which may account for this growth include the renovation and redevelopment of buildings damaged by the 1989 earthquake which is expected to result in higher density/occupancy buildings; military base reuse/redevelopment; and the proposed Mission Bay project which would redevelop a 325-acre area along the City's Bay shoreline with mixed uses including, office, recreation, residential, and commercial uses.[27]

SFWD Wholesale Customer Communities

Table 53 presents projections of population, households, and total jobs for San Francisco, San Mateo and Santa Clara counties which encompass most of the communities that comprise SFWD wholesale customers. Twenty eight of SFWD's 30 wholesale customers occur within San Mateo and Santa Clara counties.

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25 City and County of San Francisco, Department of City Planning, *San Francisco General Plan.*
26 Association of Bay Area Governments, *Projections 1996 - Forecasts for the San Francisco Bay Area to the Year 2015,* December 1995.
27 City and County San Francisco, Department of City Planning, *Mission Bay Final EIR*, August 23, 1990.

These projections are presented to provide a general picture of the magnitude and timing of growth projected to occur within the region that generally corresponds to SFWD's service area. These projections include most but not all communities/customers that SFWD serves (see Table 43, p. 437 for a list of all SFWD customers). In particular, these projections do not include wholesale and retail customers within Alameda County to which SFWD supplies a portion of their demand. The reader is also reminded that while SFWD is the sole water provider for many of its wholesale customers, for several communities SFWD is only one of several sources of supply. Thus, not all the growth projected for the wholesale customer communities is to be served by SFWD.

San Mateo County

Twenty of SFWD's 30 wholesale customers occur in San Mateo County (see Figure 61, p. 436 and Table 43, p. 437). As shown on Table 53 (p. 457), ABAG's twenty-year growth forecast for the County projects a population increase of 58,900 persons, which represents about a 8.5 percent increase between 1995 and 2015 with an average annual increase of 0.57 percent per year. The number of households is projected to increase almost 11 percent over this period, a gain of 26,670.

In the near term, between 1995 and 2005, Redwood City is projected to lead the county in household and population growth, followed by San Mateo and South San Francisco City. In the longer-term, between 2005 and 2015, Redwood City and the coastside community of Half Moon Bay and the unincorporated area around it will lead county growth. Together these areas represent 40 percent of projected County household growth over this period. San Mateo County shows an overall surplus in dwelling unit potential compared with projected household increase between 1995 and 2015. Modest surpluses are identified for all areas except Central County, where there is a small deficit. However, development in the Coastside and Remainder (unincorporated) portions of the County will depend on infrastructure availability.

ABAG identifies potential infrastructure constraints to growth as follows: road capacity could constrain growth in the North, Central and Coastside areas; water supply and distribution could constrain growth in the North County and does constrain growth in the Coastside area. Storm water drainage is also a constraint for the North County. Sewer treatment and disposal capacity are constraints on the coast. ABAG projections assume that these policy and infrastructure constraints will be resolved to provide for growth.

With respect to job growth, ABAG projects that between 1995 and 2015, the County will add about 87,400 new jobs, an increase of 28.5 percent (Table 53, p. 457). San Francisco International Airport is the county's major employer; it is expected to generate 9,400 new jobs. Most of the future economic growth is expected to occur in Redwood City, East Palo Alto, Daly City, South San Francisco, and San Mateo. Almost fifty percent of the job demand will occur in two sectors: transportation and business services.

Santa Clara County

Eight of SFWD's thirty wholesale customers occur within Santa Clara County (see Figure 61, p. 436 and Table 43, p. 437). For purposes of this analysis, ABAG projections have been modified to exclude the communities of Morgan Hill and Gilroy which are not served with SFWD water supply.

As shown on Table 53 (p. 457), ABAG's twenty year growth forecast for the County projects a population increase of about 224,150 persons which represents a 14.6 percent increase between 1995 and 2015 with an average annual increase of 0.97 percent per year. The number of households is projected to increase about 16 percent over this period, a gain of 83,940.

ABAG projects that Santa Clara County will lead the region in population growth over the 1995-2015 forecast period. San Jose will lead the County and the Bay Area region, with an expected increase of 160,100 persons and 53,200 households. Following San Jose in growth will be Sunnyvale, and Santa Clara (along with Gilroy which is not included in this analysis). ABAG analyses indicate that projected increase in households is slightly larger than the potential dwelling unit supply possible under current local land use plans and policies.

A shortfall in housing unit potential is forecast for the Central County, specifically San Jose, while a surplus is identified in the South County. Infrastructure constraints are particularly acute in the near term in the South County. Assuming these constraints are overcome, South County communities of Gilroy and Morgan Hill will represent an increasing percentage of the county's population and household growth. In the long term, they are expected to represent about 19 percent of the county's household growth.

With respect to job growth, ABAG projects that between 1995 and 2015, the County will add about 189,780 new jobs, an increase of 24 percent (Table 53, p. 457). In 1990, the County ranked fourth in the State for population and jobs. Over the years, Santa Clara County has

captured more jobs than any other Bay Area county. However, the recession affected the County significantly and between 1990 and 1993 the county lost an unprecedented number of jobs (about 54,000). ABAG projected the job recovery to begin in 1994 with a slow return to 1990-job levels by 1997. However, ABAG indicates that the County will not recover the jobs lost in the recession within the 1995-2010 period, nor will it regain the growth trend observed during the 1970-1990 period. ABAG projections indicate that the County will continue to face a long-term jobs-housing imbalance.

H. GROWTH INDUCEMENT POTENTIAL

INTRODUCTION AND OVERVIEW

Section 15126(g) of the CEQA Guidelines requires a discussion of ways in which the proposed RWMP and GWMP could induce economic, population or housing growth either directly or indirectly. A project could induce growth by reducing or removing barriers or constraints to growth (such as lack of adequate public services or utilities) or by creating an amenity that attracts new population or economic activity.

CEQA clarifies that growth itself is not the impact; rather, it is the consequences of growth, called the secondary effects of growth, that could result in adverse environmental impacts and that are to be considered in the EIR. This discussion addresses the following questions:

- Do the RWMP and GWMP have growth-inducement potential in accordance with the CEQA definition?
- How much growth could potentially occur? where and when?
- Is the potential growth consistent with applicable land use and growth plans, policies and projections?
- Could this potential growth result in adverse secondary effects on the environment? If so, can these effects be mitigated and by whom?

Water supply availability represents a potential constraint to growth and development within the SFWD service area. There is an existing and projected water supply deficit within the service area. This water supply deficit could constrain the land use development and residential, commercial and industrial growth that is planned for by the local land use jurisdictions through their General Plans and projected to occur by ABAG within the service area.

The RWMP and GWMP would provide a supplemental water supply that could reduce this potential supply deficit and the constraint to growth that it represents. The potable water both indirectly saved and directly developed by these plans represents approximately 13 percent of projected SFWD retail customer demand by the year 2010, and about 4.3 percent of total SFWD customer (wholesale and retail) demand on SFWD supply.

Thus, the RWMP and GWMP would be growth inducing, in accordance with the CEQA definition: implementation of these plans would provide a supplemental water supply that could remove "a barrier or constraint to growth." However, implementation of the RWMP and GWMP would not eliminate the existing or projected water supply deficit within the SFWD service area. These plans would not provide an amount of water that exceeds the projected demands associated with development of local General Plans or that exceeds ABAG forecast growth for the City or the SFWD service area within the next 10 to 15 years. Rather, the supplemental water would meet a fraction of the projected demand associated with planned, forecast growth.

Growth and development can have significant secondary effects on the environment such as increased traffic, congestion, air pollution, noise, loss of agricultural land, open space and habitat, and demands on public services and utilities that exceed supply. The chief growth-inducement impact concern is that projects such as the RWMP and GWMP may support growth and development that has not been planned for and consequently may occur in a disorderly manner, having significant environmental effects that have not been anticipated and addressed through mitigation to the extent possible. However, even growth that is planned for in General Plans and forecast to occur (by ABAG) may have significant, and in some case, unavoidable secondary effects. As a result, it is expected that, indirectly, implementation of the RWMP and GWMP could support additional growth which could result in significant and potentially significant unavoidable secondary effects of growth.

Exactly where and to what extent growth might be supported as a result of the supplemental water provided through these Plans is uncertain. Given the size and complexity of the SFWD water system and customer service area, there are multiple possible scenarios for how and where this supplemental water might be distributed. Under some scenarios this supplemental water would not be available to support any new growth; instead it would be reserved to serve existing customers during anticipated drought shortages through groundwater banking or similar programs. Under one scenario the supplemental water would distributed to San Francisco only. Under other scenarios, this supplemental water would be distributed to one or more of the 30-plus customers and communities within the SFWD service area.

The following analysis outlines a reasonable range of possible scenarios and discusses the growth inducement potential under each. This section generally outlines the potential secondary effects of growth; these secondary effects of growth have been or would be described in greater detail in CEQA review documents for relevant General Plans and specific development projects.

DO THE RWMP AND GWMP HAVE GROWTH INDUCING POTENTIAL?

Section E, above, (pp. 449 to 452) outlines the current and anticipated water supply deficits facing SFWD customers over the next fifteen years, customers both within the City and throughout San Mateo, Santa Clara, and Alameda counties. Given the existing and projected water supply deficits, water supply represents a potential constraint to growth within the SFWD service area. The RWMP and GWMP would reduce this potential constraint by saving imported potable water supply that could serve more growth. Therefore, in accordance with the CEQA definition, the RWMP and GWMP have growth-inducement potential. There are a number of factors that affect a) the extent to which the water supply deficit serves as a constraint to growth, b) the extent to which the potable water savings realized by implementation of the RWMP and GWMP will be available to support additional growth, and c) the overall growth inducement potential of these two Master Plans. These factors are discussed below.

Water Supply as a Growth Constraint

The extent to which a water supply shortage serves as a real constraint to growth is a question of some debate. A key factor is how closely the development approval process is linked to and guided by water supply availability. Some communities have made the tie very clear - development approval is contingent on a demonstration by the local water agency of adequate supply (e.g., the City of San Luis Obispo). Some communities have had to impose water connection moratoriums due to lack of supply (e.g., Marin Municipal Water District). However, in many communities throughout the Bay Area and the state, the approval of new development has not been directly tied to nor contingent upon a demonstration of adequate water supply availability.

Within the past decade some key regulatory and advisory/voluntary mechanisms have been enacted that strengthen the tie between development approval and water supply availability. Chief among these are: Urban Water Management Plans, the Memorandum of Understanding Regarding Urban Water Conservation in California (Best Management Practices), and the recently adopted Costa Bill SB 901.

Urban Water Management Plan

The Urban Water Management Planning Act of 1983 required every water supply agency of a given size to prepare an Urban Water Management Plan by 1985 for submission to DWR. Each plan must outline the agency's water conservation plans for the next five years. The plan is to identify specific measures and an implementation schedule. The Act was subsequently amended to require the update of these plans every five years. SFWD published its latest update in March 1996. The Act also provides that a water agency is to provide a copy of its Plan to any city or county planning agency that is proposing to adopt or substantially amend its General Plan. The Urban Water Management Plan compiles and makes available to a community, its developers and its land use decision makers important information about the area's water supply and extent of conservation planned.

Urban Water Conservation (BMPs)

In response to the SWRCB Bay-Delta hearings of 1988, several water agencies, environmental groups and others formed the Urban Water Conservation Council and developed a set of Best Management Practices (BMPs) for urban conservation. An Urban BMPs Memorandum of Understanding (MOU) has been signed by over 150 water agencies, environmental organizations and other interested parties statewide committing to implement these practices. While these BMPs largely address improving water use efficiency for existing water systems and users, they also include water use reviews and requirements for new developments. The development and implementation of the BMPs MOU has greatly heightened community awareness about water supply availability and, thus, indirectly has contributed to strengthening the tie between planning for new development and water supply.

Senate Bill 901 (1995)

In November 1995, the State enacted Senate Bill 901 which amends the Government Code relating to General Plans, the CEQA statute and the Water Code (Cal Gov. Code 65302, Cal. Pub. Res Code 21151.9 and Water Code 10910) to more closely link the processes of land use planning, environmental review, water supply planning, and development approval. The bill was developed in response to growing concern and evidence that development projects throughout the state were being approved without firm water supply commitments.

For certain large-scale projects (see Table 54), the new law requires a CEQA lead agency to identify the public water system that will serve the project and request that the water agency assess whether the projected additional water demand is covered by the agency's water supply and has been included in its Urban Water Management Plan. Specifically, the water agency is to indicate whether its total projected 20-year water supplies available during normal, single-dry, and multiple-dry water years will meet the water demands of the proposed project in addition to the agency's existing and other planned future uses. If the water agency concludes that its supplies are insufficient, it must provide the lead agency with its plans for acquiring additional water supplies, including costs, financing methods, permit and approval requirements, and timeframes. The lead agency must include this water assessment in the EIR. The lead agency must determine whether the projected water supplies will be sufficient for the project; if the lead agency determines that water supplies will not be sufficient, that determination must be included in its CEQA Findings. With enaction of the Costa Bill, development approval and water supply availability will be much more closely linked and water supply will likely become a more apparent constraint to growth.

TABLE 54: PROJECTS SUBJECT TO SB 901 PROVISIONS

- residential projects > 500 dwelling units
- shopping centers and businesses employing > 1,000 people or having > 500,000 sf floor space
- commercial office buildings employing > 1,000 people or having > 250,00 sf floor space
- hotels/motels having > 500 rooms
- industrial, manufacturing, and processing plants and industrial parks that employ > 1,000 people; occupy > 40 acres, or have > 650,000 sf floor area.
- mixed-use projects with a water demand >/= that of a 500-unit housing project

SOURCE: Senate Bill 901, November 1995.

These mechanisms notwithstanding, the fact that the City and all SFWD customers currently face a water supply deficit during drought years has not been a clear constraint on growth; it has not led to a moratorium on growth in the City nor in the peninsula communities. (Growth has been slowed by the recession.) Rather, it has lead to increased efforts in conservation, water

recycling, development of additional water supply facilities to increase storage capacity and system efficiency and, where possible, development of additional water supply such as groundwater. Thus, it is possible that the increasing water supply deficit during drought years will not serve as a direct constraint to growth.

Growth in San Francisco and within the SFWD service area may continue under current water supply conditions. If this were the case, the existing and new water customers would face potential water shortages of increasing frequency and severity, as more customers share the current water supply. The potential for and occurrence of cyclical water supply shortages eventually could discourage development and growth; in this case water supply would indirectly act as a constraint or deterrent to growth. At some point, if these water supply shortages became unacceptable, a development moratorium might be imposed through local, regional or state regulation, at which time water supply would become a clear and direct constraint to growth.

Availability of Potable Water Savings to Support Growth

There are a number of factors, summarized below, that affect whether the potable water made available by the RWMP and GWMP would increase SFWD's firm water supply and, in turn, that affect the actual growth-inducing potential of these Master Plans.

- During dry years, demand reduction coupled with supply increases is required to meet existing and projected demand. Increasing supply in dry years requires increasing storage capacity. The existing system does not have any additional water storage capacity.

- RWMP and GWMP would reduce potable water demand by serving non-potable water uses with non-potable water. GWMP would develop some additional supplies of potable water. By reducing potable water demand and providing a small addition to potable supply, the RWMP and GWMP would help reduce water shortages during dry years if the supplemental potable water supplies could be stored for use during droughts.

- By the year 2010, the potable water supply made available by the RWMP and GWMP (12.1 mgd) would represent about 13.1 percent of SFWD's retail customer demand, and about 4.3 percent of the total SFWD system demand (retail plus wholesale customers), and 3.1 percent of the total regional demand on all supply sources of SFWD's retail and wholesale customers.

- The amount of imported potable water saved by the RWMP and GWMP would not fully alleviate water shortages in drought periods and would not create a surplus of potable water in drought periods. If the first phase of the RWMP and GWMP had been implemented prior to the 1986-1992 drought, the City's potable water demand (based on 1980 water use levels) on the Hetch Hetchy/local reservoir system would have been reduced by about 8.7 percent; if the RWMP and GWMP had been fully implemented providing up to 12.1 mgd of saved and new potable water, City demand on the Hetch Hetchy system would have been reduced by about 13.8 percent. These demand reductions

could have reduced the magnitude and duration of the mandatory 25 percent water rationing imposed during the drought. However, implementation of the RWMP and GWMP would not have eliminated the need for some water rationing.

- SFWD's average annual water demand exceeds the firm delivery yield of the water supply system now. With projected increases in demand (due to projected growth), the supply deficit will increase up to 15.3 percent by the year 2010 (see Table 49, p. 448). Similarly, wholesale customer demand exceeds the supply available from SFWD and several other supply sources. A 20 percent deficit is projected by 2010 (see Table 50, p. 450). While there are potential supplemental sources of water (for the City and wholesale customers), it does not appear that these supplemental water supply opportunities will offset the deficit.

- Developing a conjunctive use program to store surface water in the City's groundwater basins, if storage space is available, could allow the City to literally save the potable water freed-up by the RWMP and GWMP for use in dry years and emergencies. Increasing surface water storage through a conjunctive use program may be possible but requires additional technical analysis and development before it is a viable project. Such a project would also undergo further environmental review and permitting as appropriate.

To examine the potential growth that could be supported by the potable water savings (12.1 mgd) as a result of the RWMP and GWMP implementation requires an assessment of who will use this additional water and where. It is the City's intention that the potable water savings be allocated first to meet its own additional water supply needs. The City has identified two main objectives for use of this saved potable water: increasing the reliability of its water supply during shortages and the restoration and long-term maintenance of Lake Merced water levels.

Specifically, as expressed in Lake Merced Policy Resolution (No. 95-0082) passed by the San Francisco Public Utilities Commission (PUC or Commission) on May 23, 1995, the City intends to study allocating the saved potable water for use in recharging the groundwater aquifer beneath Lake Merced in an effort to halt declining lake levels.[28] Through the adopted resolution, the Commission directed staff to develop a conjunctive use program for the Westside Groundwater Basin. The program is to have three goals: 1) increase and stabilize water levels in Lake Merced and the aquifer; 2) increase the reliability of the SFWD system during drought periods; and 3) develop long-term management practices that maintain the aquifer as a sustainable resource. This conjunctive use program is proposed in the GWMP as Short-term Activity 5C1 (see Project Description, p. 87).

The resolution states that the banking of potable water saved by RWMP and GWMP implementation in the aquifer could provide additional water for City water users during drought

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[28] City and County of San Francisco, Public Utilities Commission, *Resolution 95-0082 - Lake Merced Policy Resolution*, May 23, 1995.

periods. However, until the City develops such a groundwater storage program (or other storage facilities) it can not bank the saved potable water. In wet and normal years, SFWD's system lacks sufficient surface water storage capacity to store this additional water. If the water is not used, it would spill from the system to the environment (river to ocean) and would not be available for consumptive use or lake restoration efforts.

The PUC Lake Merced policy resolution further states that "if a portion of the water [made available through the development of water recycling and groundwater in San Francisco] is not needed to increase the reliability of water supplied to City water users, the water may be sold to others in order to reduce the cost of the water recycling program to City water users."[29] The ultimate disposition of the supplemental water created by building recycled water and groundwater facilities is dependent on additional studies and an evaluation of the financial and environmental feasibility of storage options. These will be examined in the City's (upcoming) Water Supply Master Plan effort.

In theory, there are numerous possible scenarios of how the saved potable water might be used, where, when and by whom. The saved potable water would remain in the Hetch Hetchy system since there currently are no existing, planned or proposed storage program. Thus, technically the saved potable water could be allocated in full or part to any of the communities/customers connected to the system. However, as outlined in the PUC resolution, a more likely scenario is that San Francisco will study banking this water to increase system reliability and the potential sale of some of this water to one or more of its wholesale customers.

Maximum Potential Growth Scenarios

The following analysis describes the potential population growth that could be supported if all the saved potable water was allocated to new growth. The potential population that can be served by a fixed amount of water depends on the amount of water used by each person per day (gallons per capita per day [gpcd]). Per capita water use varies greatly within the San Francisco Bay region, depending on factors such as climate, income, population density, residential yard size, and volume of commercial and industrial use within the community. Cooler coastal areas have the lowest per capita water use rates. Within the Bay Area low use rates of about 100 gpcd

[29] City and County of San Francisco, Public Utilities Commission, *Resolution 95-0082 - Lake Merced Policy Resolution*, May 23, 1995.

in coastside San Mateo County and of 119 gpcd in San Francisco have been observed.[30] Prior to the recent drought, San Francisco's per capita rate stabilized at about 140 gpcd. The City may experience some increase in per capita rate from the post-drought low of 119 gpcd back towards the 140 gpcd rate. Bayside communities in Marin and Sonoma counties use about 170 gpcd. Santa Clara County's per capita rate averages about 200 gpcd as a result of a warm, dry climate, a high level of outdoor use, a broad range of housing densities including very low density, and a mix of water-using industries including food processing and electronics. Among the highest per capita use rate is Contra Costa County's at 230 gpcd, attributed to the many large, estate-size lots which have high landscape irrigation water demands.

For purposes of providing a reasonable yet conservative analysis of growth inducement potential the following discussion addresses two of the many possible scenarios: a) the saved water supports additional growth within a community that has a low per capita water use rate - San Francisco County, and b) the saved water supports additional growth in a community that has a high per capita water use rate - Santa Clara County. These two scenarios frame the maximum growth inducement potential the RWMP and GWMP implementation could have if all saved water is allocated to new growth.

San Francisco County Growth Scenario

By the year 2011, implementation of the RWMP and GWMP could result in a potable water savings of 12.1 mgd (Table 51, p. 455). At a per capita rate of 119 gpcd, this amount of water could support a population increase of 101,681 persons. ABAG projects a population increase for San Francisco of 40,700 by 2010 (Table 52, p. 456). Thus, at this low rate of water use, the potential potable water savings could support a population increase that is 150 percent, or about 60,981 people, greater than that projected by ABAG for the City. Using the per capita rate of 140 gpcd observed in San Francisco in the 1980's before the recent drought, the supplemental water could support a population of about 86,400 persons. This population increase in 123 percent of the projected ABAG increase by 2010. It is unlikely that the availability of this supplemental water supply would induce growth much beyond that projected by ABAG, because, as described by ABAG, growth in San Francisco is not constrained by water supply but rather by housing costs, employment opportunities, and developable land.

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30 San Mateo County information from: Department of Water Resources, *California Water Plan Update (Bulletin 160-93), Volume 2*. October 1994. San Francisco information from: Public Utilities Commission of the City and County of San Francisco, *Urban Water Management Plan for the City and County of San Francisco,* March 1996.

Santa Clara County Growth Scenario

At a per capita rate of 200 gpcd, 12.1 mgd of potable water could support a population increase of 60,500. As described in Section G., Growth Projections (pp. 460 to 461), Santa Clara County is expected to lead the Bay Area in population growth. ABAG projects a county-wide population increase of 224,150 (excluding Morgan Hill and Gilroy) by 2015. The 60,500 population increase supported by the RWMP/GWMP potable water contribution represents 27 percent of the projected growth for the County.

Potential Growth - Summary

It is likely that the San Francisco will first meet its own City water supply needs with the water saved by implementing the RWMP and GWMP and will have some additional water that can be used to meet supply needs elsewhere in its service area. Thus, this supplemental water would support planned growth within the City and possibly in one or more additional communities.

At this time it is too speculative to predict exactly where the "saved" water will be used. However, the maximum growth scenarios described above for San Francisco and Santa Clara County provide the nature and magnitude of growth support that could result within the SFWD service area. Because the RWMP and GWMP would not provide water supply that would exceed projected demand associated with planned growth, the secondary effects of growth are those associated with implementation of the General Plans and development projects approved by the local land use agencies within the SFWD service area. The final section summarizes the types of significant and significant unavoidable impacts that are anticipated to occur with buildout of planned growth in the communities within the SFWD service area.

I. SECONDARY EFFECTS OF GROWTH

The supplemental water resulting from implementation of the RWMP and GWMP would support growth within the SFWD service area that is well within the level of growth planned by the local land use jurisdictions. (The supplemental water represents 4.3% of the projected water demand to be meet planned growth within the SFWD service area.) The impacts of planned growth and development are addressed in the CEQA EIRs for General Plans and specific development projects in the many communities that comprise the SFWD service area. The impacts associated with planned growth most commonly identified as significant include:

- unacceptable traffic conditions on local roadways
- air pollutant emissions exceeding BAAQMD significance thresholds
- conversion of farmland/prime soils to urban uses
- unacceptable traffic conditions on regional highways
- increase noise due to traffic increases
- loss of open space and habitat with impacts to wildlife and plants
- inadequate water supply
- inadequate wastewater treatment and/or disposal capacity

In some communities, some of these significant impacts may be unavoidable. The San Francisco PUC does not have the authority to make land use and development decisions. It does not approve growth; its role is to provide adequate water supply service to San Francisco and its contract wholesale customers in accordance with its contract agreements. The PUC does have the ability to help mitigate the effects of planned growth on water supply by implementing programs such as the RWMP and GWMP to conserve potable water supplies and develop supplemental supplies. By reducing demand for potable water and producing additional water supplies locally, implementation of these two plans would help avoid or delay the need for development of additional imported water or groundwater supply and facilities. Implementation of these plans alone would not eliminate the water supply deficit projected for San Francisco or SFWD other customers, but they would contribute to mitigation of increasing water demand due to growth.

The PUC does not have the authority or jurisdiction to implement mitigation measures necessary to address many of the significant secondary effects of planned growth. Authority to implement such mitigation measures lies with the individual city and county land/development approval agencies which enforce local, state, and federal regulations and mitigation requirements through the land use permit process. Other agencies with authority to require or implement mitigation to address the effects of growth and development include regional and state agencies such as Caltrans, Department of Fish and Game, BAAQMD, RWQCB, DHS, DTSC and federal agencies such as US Fish and Wildlife Service, Corps of Engineers and EPA.

MITIGATION MEASURES PROPOSED TO MINIMIZE POTENTIAL ADVERSE IMPACTS OF THE PROJECT

CHAPTER VII

MITIGATION MEASURES PROPOSED TO MINIMIZE POTENTIAL ADVERSE IMPACTS OF THE PROJECT

INTRODUCTION

During the course of formulation and analysis of the proposed RWMP and GWMP, program and project level measures have been identified that would reduce or eliminate potential environmental impacts resulting from implementation of either or both plans. Some of these measures have been, or would be adopted by the Project Sponsor, the San Francisco Public Utilities Commission (PUC), or project engineers/contractors, and thus are listed as included in the project; some are under consideration. Measures under consideration may ultimately be included in the project by PUC, or possibly be required by a decision-maker on the project as conditions of approval of the RWMP and/or GWMP. Program level measures address system-wide aspects of Plan implementation, while project level measures address impacts associated with operation or construction of some or all of the facilities that are proposed under the RWMP or GWMP.

In addition to the mitigation measures below, there are several items required by law which would also serve to mitigate impacts. These measures include: compliance with state and federal water quality standards for public health (Title 22) of the California Code of Regulations, limitation of construction-related noise levels, pursuant to the San Francisco Noise Ordinance (Article 29 of the San Francisco Police Code, 1972), and observance of state and federal regulations (including OSHA safety requirements) related to handling and disposal of hazardous materials including friable asbestos. Some measures described in this chapter may be required under these or other legal requirements, indicated as "*Required by Law*," and are listed here for informational purposes.

Mitigation measures listed below are also separated by project phase to indicate when mitigation implementation and enforcement would occur. Those listed under the Planning and Design Phase would be implemented either as part of review and adoption of the RWMP and GWMP or during design of specific facility improvements that would occur as a result of plan implementation. These would include measures that would be incorporated as plan policies, geotechnical and other technical studies that need to be completed prior to facility design, and

measures that would be incorporated into the facility design. Those measures listed under the Construction Phase would be implemented prior to, during, and immediately after construction. Those measures include development of specific programs for mitigation enforcement, baseline monitoring, construction scheduling, and revegetation requirements following construction. Remaining measures are listed under the Operation Phase and they would be implemented over the long-term operation of project facilities.

ENFORCEMENT OF MITIGATION MEASURES

As of January 1, 1989, the California Environmental Quality Act (CEQA) requires that a monitoring and reporting program be adopted regarding mitigation measures that are made conditions of project approval for any project which would otherwise have significant environmental effects. As such, any alternatives selected by the Project Sponsors and proposed to the Board of Supervisors for approval would include a mitigation monitoring and reporting program to ensure compliance with all mitigation measures required as conditions of approval of the RWMP and/or GWMP. The reporting program would periodically present results of mitigation monitoring activities during construction to the Department of City Planning and other responsible agencies; any reporting requirements during operation of the projects would be submitted to the appropriate responsible agency. The details of the mitigation monitoring and reporting program, which could include activities by the Project Sponsors, the Department of City Planning, other City agencies, or other responsible agencies, would be included in the final presentation of the proposed RWMP and GWMP to the Board of Supervisors. The implementation of the mitigation monitoring program during construction phase for City-sponsored project is generally conducted by the Bureau of Construction Management. Actual implementation of mitigation measures would be subject to future revision due to changed circumstances following project approval; these may include changing regulatory requirements, changes in the responsibilities of the regulatory agencies, improved monitoring technologies, and other unforeseen conditions.

A. LAND USE/VISUAL

Measures Proposed as Part of the Project - Both RWMP and GWMP

None required.

Measures Proposed as Part of the Project - RWMP Only

Construction Phase

A-1. To compensate for the loss of recreational use at the Lincoln High School and McLaren Park reservoir sites, recreational resources would be rehabilitated to the extent possible in addition to being restored. The grass fields and football facility at Lincoln High School would be rebuilt and restored in consultation with the School District. McCoppin Square Park would be restored with turf grass in consultation with the Recreation and Park Department. At McLaren Park reservoir site, the disturbed areas and park paths disrupted during construction would be restored to pre-existing or better conditions in consultation with the Recreation and Park Department. Other areas within these parks would also be rehabilitated as necessary (erosion-control and landscaping measures) to mitigate for heavier use of these other areas resulting from project-related displacement of park users. The McLaren Park reservoir site and pipeline route would be restored to its prior condition, including replacement and reseeding of affected vegetation and repavement or regrading of any paths or roadways.

A-2. Access to alternative recreation sites for school students and park users would be provided to the extent feasible during construction. The PUC would work with the School District to find alternative means of accommodating the school's needs during construction. Alternative sites for physical education would be upgraded for usability, such as basketball courts and gym areas, to limit the amount of bus transportation required to games. Park paths affected by reservoir construction in McLaren Park would be temporarily relocated around the construction site to allow continued use during construction.

A-3. Landscaping would be planted around the valve vault at the Lincoln High School reservoir site to screen the view of the structure from Santiago Street.

Measures Proposed as Part of the Project - GWMP Only

Construction Phase

A-4. If the existing Elk Glen Well cannot be rehabilitated and needs to be replaced, SFWD would coordinate with the Recreation and Park Department to determine whether the replacement well could be installed in the immediate vicinity of the existing well or if there is another suitable location. Well facilities could be relocated within the Elk Glen area further from the lake to mitigate land use and visual impacts.

A-5. During Elk Glen Well construction, the Elk Glen Lake path would be re-routed around the construction site in order to maintain use of the path during the eight-week construction period. Upon completion of construction, the path would be restored at its current site or would be permanently re-routed around the disinfection station, as determined in consultation with the Recreation and Park Department.

A-6. Upon completion of Elk Glen Well construction (whether the existing well is rehabilitated or a new well is constructed in the immediate vicinity), the area disturbed by construction at the Elk Glen Well site would be regraded to its pre-existing contours and would be revegetated. SFWD would coordinate with the Recreation and Park Department to select species and design for revegetation. In addition, vegetation would be planted around the chlorination station to mitigate its visual impact in this undeveloped area.

A-7. After completion of production well construction at Francis Scott Key School, the surrounding play area would be restored and any playground facilities previously located on the site (i.e., basketball courts, etc.) would be replaced adjacent to the site.

A-8. After completion of production well construction at West Sunset Playground, the surrounding parking lot would be restored to its pre-existing condition.

B. GROUNDWATER AND SURFACE WATER RESOURCES

Measures Proposed as Part of the Project - Both RWMP and GWMP

Operation Phase

B-1. During long-term operation of both the RWMP and GWMP, periodic groundwater quality monitoring would be conducted at RWMP landscape irrigation sites and at GWMP well sites (production/extraction, injection, and monitoring wells) to assure that groundwater quality is maintained at levels suitable for designated uses, as required by the California Regional Water Quality Control Board (RWQCB) for the RWMP and as required by the Department of Health Services for the GWMP. Groundwater collection would be conducted according to standard accepted procedures including: collection of groundwater quality samples; chain-of-custody and sample handling procedures; laboratory analytical methods and reporting limits; appropriate groundwater quality parameters to be analyzed as needed for different sampling objectives; frequency of sampling, and data management and reporting. *(Required by Law)*

Groundwater monitoring data from all sites under both plans could be collectively maintained as part of the City's groundwater database developed as part of GWMP Activity 1C1 and managed by the proposed groundwater management unit of the SFWD (GWMP Activity 2A1).

B-2. The City would coordinate with the RWQCB as necessary regarding groundwater quality data collection and reporting as it relates to any waste discharge requirements or protection of groundwater resources from degradation. The City would coordinate with the San Francisco Department of Public Health (SFDPH) and the California Department of Health Services as necessary regarding groundwater as a potable water supply source and compliance with Drinking Water Standards. *(Required by Law)*

Measures Proposed as Part of the Project - RWMP Only

Construction Phase

B-3. The construction contractor would prepare a construction dewatering plan for the RWTP site and any reservoir sites (possibly Lincoln High School site) that could require dewatering. The plan could include hydrologic modeling to determine the maximum potential extent of groundwater drawdown effects; monitoring wells to measure groundwater levels and quality; disposal options for dewatering discharge as necessary; and permit requirements for well installations and disposal. Details of the plan depend on the facility and individual site constraints.

B-4. During construction dewatering activities at any of the RWMP sites, groundwater levels and quality at nearby wells would be monitored on a regular basis where determined to be necessary based on the dewatering plan. Monitoring would occur before (baseline), during (impacts) and after (recovery) dewatering activities, and monitoring wells would be installed as necessary prior to construction. Impacts and recovery of groundwater levels and quality would be compared to baseline conditions. Baseline conditions together with groundwater uses at nearby wells would be used to determine threshold levels requiring corrective action for dewatering activities. Periodic monitoring of nearby wells would assure that groundwater quality is not affected (including potential impacts from saltwater intrusion or migration of contaminants from off-site sources), and changes in groundwater levels do not affect well operations.

Specifically, to monitor potential effects of construction dewatering activities at the RWTP Fleishhacker Pool site on the existing Zoo wells, water quality monitoring would be conducted at the Zoo wells, prior to, during and after construction of the RWTP. Observation wells would be installed west of the construction site and between the site and the Zoo wells for the purpose of tracking chloride concentration as an indicator of saltwater intrusion. Should saltwater appear in the observation wells, the City would provide surface water supply to the Zoo and discontinue operation of the Zoo wells during the dewatering period, since they would tend to contribute to eastward migration of the saltwater interface. Refer also to Hazardous Materials Mitigation Measure F-13 for monitoring of potential contaminants in the groundwater from the former Chevron station during dewatering activities.

B-5. Depending on the quality of the groundwater generated from dewatering, disposal of the discharge would be either to the combined sewer system (subject to the requirements of the Industrial Waste Ordinance, Article 4.1 of the San Francisco Public Works Code) or directly to surface waters, such as the ocean or Lake Merced (subject to approval by the RWQCB). *(Required by Law)*

Operation Phase

B-6. To protect surface water quality from recycled water runoff, the City would comply with RWQCB Water Reclamation/Reuse Requirements for runoff as applicable. *(Required by Law)*

B-7. During operation of the RWMP, the SFWD would coordinate with recycled water users at landscape irrigation sites. The SFWD would provide new recycled water users (customers) with information regarding recycled water quality, including nitrate and total nitrogen content, and explaining the differences between water quality of groundwater, potable water and recycled water, so that appropriate adjustments can be made to fertilization management The levels of nutrients in the recycled water should offset fertilizer application to some degree, and addition of supplemental nitrogen to landscape areas should be reduced. It is generally recommended that total combined nitrogen application in recycled water and fertilizer not exceed plant requirements to avoid infiltration of nitrate reaching the groundwater. Refer to Public Health and Water Quality Mitigation Measure C-3 below for associated measures regarding monitoring.

Measures Under Consideration

Construction Phase

B-8. If the planned new Zoo wells are not yet installed at the time dewatering activities occur at the RWTP site, then, as a precaution to minimize effects of dewatering pumping on the performance of Zoo wells, a pump efficiency test could be performed prior to construction to establish a baseline of pump performance, and this test could be repeated if there is evidence that well performance has declined. The City could also fund increased pumping costs, if Zoo staff demonstrate that those costs have exceeded normal operating costs for the season and level of use. Normal operating costs and water levels could be established prior to dewatering and could be included in contractor bid specifications.

Measures Proposed as Part of the Project - GWMP Only

Planning, Design and Operation Phase

B-9. Concurrent with implementation of short-term activities 5A1 and 5A2 (production wells at Elk Glen and Sunset District), short-term activities associated with GWMP Goals 1, 2, and 3 would be implemented. In particular, the following actions would be conducted: Establish a Groundwater Management Unit (Activity 2A1), Saltwater Intrusion Prevention (Activities 1A1 and 1A2), Wellhead Protection Program (Activity 1B1), Groundwater Monitoring Program (Activity 1C1), and Lake Merced Investigations and Modeling (Activities 3A1 and 3A2).

C. PUBLIC HEALTH AND WATER QUALITY

Measures Proposed as Part of the Project - Both RWMP and GWMP

Operation Phase

C-1. The SFWD, as water purveyor for both recycled water and groundwater, would notify the public of the proposed changes in water supply sources for various designated uses. Notification could occur through the existing Consumer Relations program of the SFWD. The SFWD would provide specific information concerning dates of RWMP and GWMP implementation, water quality, and public health safeguards (such as compliance with applicable standards and on-going monitoring). The SFWD would be responsible for notifying designated users of recycled water and providing information regarding recycled water quality, signage, plumbing, cross-connection and public health issues (see Measure C-6). The SFWD would also be responsible for notifying the public of proposed incorporation of groundwater into the City's potable water supply system.

Measures Proposed as Part of the Project - RWMP Only

Construction Phase

C-2. Recycled water pipes would be labeled and color-coded purple to distinguish them from potable water pipes. Other measures, including use of backflow prevention devices on

potable water systems, would be employed to prevent cross-connection with the potable system (in accordance with Title 17). Backflow prevention assemblies must be approved for use by the California Department of Health Services, as indicated by the Division of Drinking Water and Environmental Management (April 1994 List). *(Required by Law)*

Operation Phase

C-3. During operation of the RWMP, water quality monitoring of recycled water would be conducted for all parameters required under Title 22 Wastewater Reclamation Criteria. Water quality monitoring would be reported to the RWQCB and SFDPH as required. PUC would be responsible for operating the RWTP, which includes meeting and monitoring water quality requirements of Title 22 water reclamation criteria, including coliform, turbidity, pH adjustment and chlorine dose. The PUC may provide water quality analysis beyond what is required by Title 22 requirements if the additional parameters are required as part of other permit requirements. The SFWD would be responsible for distribution and storage of recycled water and for any additional water quality monitoring at reservoirs or user sites as required by the RWQCB, see Measure C-4 below. *(Required by Law)*

C-4. The City would coordinate with RWQCB to develop and implement suitable Water Reuse Requirements applicable specifically to the City's proposed RWMP over the long-term operation of the program. These Water Reuse Requirements would include the following: (1) level of proposed recycled water treatment (i.e., disinfected tertiary water suitable for unrestricted uses); (2) the proposed distribution and storage system, particularly with respect to dual land uses at facility sites; (3) the currently identified users as well as future unidentified users and type of users; (4) restrictions on use; and (5) self-monitoring program. *(Required by Law)*

C-5. In conjunction with the Water Reuse Requirements/Waste Discharge Requirements under the RWQCB, the City would be required to prepare an Engineering Report in compliance with Title 22 Wastewater Reclamation Criteria. The Engineering Report would also be subject to approval by the California Department of Health Services and would include: (1) demonstration of compliance with Title 22 regulations; (2) description of recycled water treatment plant reliability features; (3) description of supplemental water supply; (4) monitoring program; and (5) contingency plan to ensure that no untreated or partially treated wastewater enters the distribution system. *(Required by Law)*

C-6. The SFWD would be responsible for providing recycled water quality information to recycled water users. An initial information packet would be provided to site users to assist them in site-specific water quality management. For example, irrigation users would be informed of nitrate and other nutrient data in the recycled water so they can manage fertilizer application accordingly. Irrigation users would also be informed of pH and corrosion potential of the recycled water so that users can make appropriate adjustments to reduce potential corrosive effects to irrigation system pipelines. For industrial users, calcium, magnesium, total dissolved solids or biological oxygen demand (BOD) may be of concern, and recycled water quality information can be used by individual users so that they may perform on-site water quality adjustment as necessary. In addition, the SFWD information packet would include phone numbers to call in case of emergencies and information on back-up water supplies in the event of an upset to the recycled water system.

C-7. The City would provide a high degree of operations reliability at the RWTP. These measures would assure a consistently high-quality water that meets Title 22 standards as well as a reliable production of recycled water from the facility. Measures to assure

consistently high-quality water would include design features such as continuous on-line monitors for constituents such as pH, turbidity, chlorine residual, conductivity, etc.; monitors with high and low set point for acceptable operating levels; and monitors equipped with alarms and systems that could trigger automatic plant shutdown in the event of an upset. The system would also include back-up storage, influent monitoring, and standby power.

C-8. The City would comply with Title 22 and Department of Health Services guidelines regarding use and handling of recycled water as well as RWQCB Water Reclamation Requirements. *(Required by Law)*

Typically, recycled water use restrictions under these guidelines would include:

a. Spray of recycled water would not be allowed to contact drinking water fountain nozzles.

b. There would be no irrigation with, or impoundment of tertiary recycled water within a minimum of 50 feet of any drinking water supply well. This could include the rehabilitated Elk Glen Well, as proposed under the GWMP to be a potable water production well.

c. The following provisions would be made by the recycled water user for workers who handle recycled water or may be exposed to it (this could include treatment plant workers, irrigation workers, and fire fighters):

- The employer (recycled water user) would notify workers that recycled water is in use and that it is not suitable for ingestion. Notification would include the posting of conspicuous signs at the work place, that present the following wording in size that could clearly be read by the workers: "*RECYCLED WATER -- DO NOT DRINK*"

- The recycled water user would assure that potable water is supplied for workers for drinking and washing hands and face. Where bottled water is provided, the water would be in separate, boldly labeled, contamination-proof containers protected from recycled water and dust.

C-9. Signs would be posted at user sites indicating use of recycled water. The SFWD would coordinate with all users regarding proper signage as part of their monitoring of use and cross connection issues.

C-10. Fire fighters would be specifically informed of the public health concerns associated with recycled water in the AWSS water supply. The SFWD would work with SFFD to establish procedures whereby potable water would be provided to the fire fighters for consumption during fire fighting situations. The SFWD would coordinate with SFFD on a regular basis during the phased implementation of the RWMP so that fire fighters are fully informed of the recycled water connections and back-up availability to the AWSS.

Measures Under Consideration - RWMP Only

C-11. The SFWD would provide back-up water supply systems for recycled water users as needed on a case-by-case basis. In particular, some industrial users may require a back-up water supply to provide adequate system reliability in the event of a prolonged failure of

the recycled water system (more than one day). The back-up water source could be City water or groundwater.

Measures Proposed as Part of the Project - GWMP Only

Operation Phase

C-12. The SFWD would conduct regular monitoring of groundwater quality from proposed production wells for public health parameters. The results would be reported regularly to SFDPH and DOHS, as required. At all wells proposed for potable use (including the Elk Glen and Sunset District wells), drinking water standards would be monitored as required by Title 22, Chapter 15. The SFWD would be responsible for monitoring groundwater, for overall Citywide basin management and for individual proposed production wells. In particular, the SFWD would regularly monitor groundwater quality for nitrate where it is proposed for potable water supply where recycled water would be used for irrigation, such as Golden Gate Park. *(Required by Law)*

C-13. The SFWD would notify the City's water customers about groundwater blending from the Elk Glen and Sunset District wells with current surface water sources, and any water quality changes, including possible changes in taste/odor and hardness, and possible effects on use would be described.

D. PUBLIC SERVICES AND UTILITIES

Measures Proposed as Part of the Project - Both RWMP and GWMP

Construction Phase

D-1. During final design, the PUC would provide notification to other utility companies (such as PG&E) of proposed schedule, alignment, and extent of pipeline construction in roadways so as to minimize disruption to other existing utility lines and to minimize inconvenience to customers. If necessary, PUC would coordinate any necessary relocation of other utilities. Pipeline construction would be scheduled to minimize noise, dust and other disruption to local residences and businesses.

Measures Proposed as Part of the Project - RWMP Only

Planning and Design Phase

D-2. If the results of the on-going ocean outfall study indicate that zero or low flow to the outfall would result in operational problems, then PUC would address the potential impacts of zero flow to the outflow as part of their study, and if recommended, corrective actions to either the design or operation/maintenance of the outfall would be implemented. This could include maintenance of a minimum flow through the outfall.

Measures Proposed as Part of the Project - GWMP Only

None Required.

E. GEOLOGY, SOILS, AND SEISMICITY

Measures Proposed as Part of the Project - Both RWMP and GWMP

Planning and Design Phase

E-1. Detailed, site-specific geotechnical investigations would be conducted for all proposed project sites by a qualified geotechnical consultant prior to final design of proposed facilities. The geotechnical investigations and studies would include field exploration, subsurface exploration, laboratory testing and engineering analyses to evaluate the following: soil and rock stability; slope stability; on-site drainage for subsurface structures; soil characteristics for corrosivity, permeability, liquefaction and densification; soil lurching and lateral spreading; differential settlement; and foundation support and design. The studies would include development of construction, excavation, and design measures required to ensure public safety, structural integrity, and protection of existing structures during construction and operation phases of the facilities. Precautions, such as underpinning or shoring, as determined by site-specific geotechnical investigations, may be necessary to prevent settlement of nearby existing structures during and after construction. The Project Sponsors would implement all feasible recommendations of the geotechnical investigations and studies during final design and construction of proposed facilities.

E-2. To address seismic shaking hazards, project structures and foundations would be designed in accordance with building codes and standards based on San Francisco's seismic requirements. These standards take into account the potential levels of seismic shaking and amplification due to soil type and thickness. *(Required by Law)*

E-3. Grading and drainage facilities would be designed to divert runoff away from excavations, pipelines, and surface and subsurface structures to prevent damage or settlement of facilities. A grading plan and erosion control measures would be included in the plans and specifications for the project.

E-4. At the RWMP and GWMP construction sites, soils would be evaluated for corrosivity, and depending on the outcome of the evaluation, a corrosion monitoring and protection system would be installed as needed. Installation of piping would include appropriate joint bonds and test stations to monitor external corrosion.

Construction Phase

E-5. At construction sites, to prevent erosion of stockpiled soils and sandy slopes, a project construction phase plan would be developed and would include measures such as:

a. Stockpiles would be covered and the area of stockpiling would be bermed with haybales or other approved materials to prevent runoff to the storm drain system.

b. A stormwater pollution prevention plan meeting the requirements of the Regional Water Quality Control Board would be developed for the facility sites (recycled water treatment plant and reservoir sites).

c. The plan would include provision for the use of sediment catchment barriers to control runoff during construction.

Additional measures, such as daily watering of exposed soils, covering of stockpiles, and stopping work during windy conditions, are listed in Air Quality Mitigation Measure H-1.

Measures Proposed as Part of the Project - RWMP Only

Planning and Design Phase

E-6. The detailed site-specific geotechnical investigations conducted at the Fleishhacker Pool site would specifically address potential for liquefaction at that site. To prevent the potential impacts of liquefaction, special seismic resistant design may be required for the RWTP at this site and may require soil densification or removal or treatment of liquefiable soil. The PUC would implement all feasible recommendations of the geotechnical investigations to minimize the impacts of liquefaction.

E-7. More detailed site-specific geotechnical investigations would be conducted to characterize the bedrock surface at the Lincoln High School and McLaren Park reservoir site and to determine effective engineering design solutions to prevent differential settlement after construction of the reservoirs. For sites where unsuitable foundation materials are identified, possible solutions include removal of unsuitable soils and replacement with engineered fill. For sites where both bedrock and unconsolidated material are present at the bearing depth, recommendations may include installation of a transition foundation using pilings in the areas of unconsolidated material to transfer the load to the underlying, more competent, bedrock. Alternatively, the reservoir site may be over-excavated to a depth where consistent geologic materials are present and compacted fill could be placed to bring the excavation to the appropriate depth for construction of the reservoir. At sites where steep bedrock slopes are present, reservoir set backs and benching would be required to provide a suitable bearing material for the reservoirs.

E-8. Engineering recommendations for shoring of all temporary excavations would be implemented, including all OSHA required safety precautions. Shoring requirements could include H-pile and lagging, braced excavations, soils nailing, tie backs, chemical grouting, rock nailing/bolting, or similar methods as necessary to mitigate against slope instability within the excavations during construction.

Measures Under Consideration - GWMP Only

Planning and Design Phase

E-9. The SFWD would conduct additional investigations and future modeling for subsidence due to groundwater extraction at the Elk Glen and Sunset District wells once additional site-specific data are available to confirm and update the modeling results. The SFWD would implement recommendations from these investigations as necessary to minimize the potential for subsidence.

F. HAZARDOUS MATERIALS

Measures Proposed as Part of the Project - Both RWMP and GWMP

Planning and Design Phase

F-1. In addition to the review completed as part of the background research for this EIR, a subsequent, updated review of regulatory agency listings would be conducted prior to facility and pipeline construction at and along each specific site and alignments to identify and update the status of known or suspected hazardous waste contamination and whether remediation is occurring at these sites. Any information indicating the potential for hazardous materials contamination to occur at any of the project sites would be verified and appropriate information on known hazardous materials and any requirements for hazardous materials removal, abatement, remediation, handling and disposal would be included in contract specifications (see Measure F-2, below).

Construction Phase

F-2. All available information on potential contaminants at the construction sites from the site history review would be made available to the construction contractors as part of the contract specification processes for construction of all proposed facilities. This would provide the contractors with knowledge of known hazardous materials which could be encountered during construction.

F-3. Contractors would be required to prepare for and report any visible evidence of previously unidentified hazardous materials, such as soil discoloration, suspicious odors, or presence of underground tanks, piping or other buried building materials encountered during construction. The Project Sponsor would have a contingency plan, requiring the contractor to sample and analyze potentially hazardous substances, and would coordinate with the regulatory agencies.

F-4. If hazardous substances are identified in subsurface materials prior to or during construction at any of the project sites, the contractor would be required to have a site-specific health and safety program. A contractor's Site Safety Officer should be designated to oversee implementation of this program and to coordinate with applicable regulatory agencies. The Project Sponsor would oversee the performance of any required sampling and investigation plans, and special removal, abatement, remediation and disposal requirements, whether performed by the construction contractor or by qualified persons. Any site investigations or remediation would be performed in accordance with applicable laws and regulations. Typically, the SFDPH would be the responsible agency for any releases of hazardous substances from underground storage tanks; the RWQCB could be involved if the groundwater or surface water were contaminated and the California Department of Toxic Substances Control (DTSC) could become involved if soils were contaminated. *(Required by Law)*

F-5. All potentially contaminated materials encountered during project construction activities would be tested in conformance with applicable local, state, and federal regulations and/or guidelines governing hazardous waste to determine specific soil and groundwater handling and disposal requirements. Under current RWQCB policy, soil removed from utility excavations may be reused as backfill. However, any materials used in construction of the utilities should be compatible with chemicals that may be present in the soil and also the groundwater, if groundwater should be present within the utility excavation. Any excess

soils that cannot be placed back in the excavation would need to be tested to determine appropriate disposal requirements if the presence of hazardous materials is indicated. If substantial contamination is present (but not necessarily hazardous waste levels), the DTSC may prohibit, in the absence of a variance, use of excavated soils as backfill for non-maintenance utility work or other substantial construction. *(Required by Law)*

F-6. Excess excavated material containing potentially hazardous contaminants would be hauled directly from the excavation or contained within a stockpile area for further classification. The stockpile area would be covered and designed with berms or other engineering controls to ensure that no contaminated runoff reaches the soil or sewer system. *(Required by Law)*

F-7. Groundwater discharge from excavations which would require further testing to determine handling or disposal options would be contained in systems, such as drums, settling tanks or tank trucks, which meet regulatory requirements for the potential contaminants involved. Groundwater brought to the surface would be contained and tested prior to disposal. Quality of the discharge must meet requirements of the San Francisco Industrial Waste Ordinance for disposal to the sewer system. If quality of the discharge does not meet the requirements for sewer disposal, the dewatering water could be treated on-site or disposed of to an acceptable off-site facility. *(Required by Law)*

F-8. All materials determined to be hazardous would be remediated and/or disposed of according to applicable regulatory agency regulations and/or guidelines (e.g., including use of tarps to cover soils during transport, use of haulers that have been trained and certified according to requirements of the US Department of Transportation, the California Highway Patrol, and Cal/EPA's Department of Toxic Substances Control). *(Required by Law)*

F-9. California OSHA standards would be followed in the handling and storage of fuels and other flammable materials to ensure worker protection and spill prevention. These measures include appropriate storage of flammable liquids, and prohibition of open flames within 50 feet of flammable storage areas. *(Required by Law)*

F-10. In the event serpentinite deposits are encountered during facility construction and found to contain asbestos fibers, the contractor would be required to transport and dispose of excavated asbestos-containing materials in accordance with California law. *(Required by Law)*

Measures Proposed as Part of the Project - RWMP Only

Planning and Design (Pre-Construction) Phase

F-11. Asbestos-containing materials may be found within the existing Fleishhacker Bath House which is proposed to be demolished prior to construction of the RWTP. The Project Sponsor would require that a building survey be conducted by appropriately certified personnel to identify the extent of asbestos containing materials, lead-containing materials, and other hazardous materials before any demolition to the Fleishhacker Bath House structure at the Fleishhacker Pool site occurs. *(Required by Law)*

If asbestos, lead, or other hazardous materials are found, the following measures would be required:

a. Asbestos

(i) Section 19827.5 of the California Health and Safety Code, adopted January 1, 1991, requires that local agencies not issue demolition or alteration permits until an applicant has demonstrated compliance with notification requirements under applicable federal regulations regarding hazardous air pollutants, including asbestos. The Bay Area Air Quality Management District (BAAQMD) is vested by the California legislature with authority to regulate airborne pollutants, including asbestos, through both inspection and law enforcement, and is to be notified ten days in advance of any proposed demolition or abatement work. If asbestos is identified during the building survey, the Project Sponsor would be required to comply with these regulatory and notification requirements. *(Required by Law)*

(ii) Notification includes the names and addresses of operations and persons responsible; description and location of the structure to be demolished/altered including size, age and prior use, and the approximate amount of friable asbestos; scheduled starting and completion dates of demolition or abatement; nature of planned work and methods to be employed; procedures to be employed to meet BAAQMD requirements; and the name and location of the waste disposal site to be used. The District randomly inspects asbestos removal operations. In addition, the District will inspect any removal operation concerning which a complaint has been received. *(Required by Law)*

(iii) The local office of the State Occupational Safety and Health Administration (OSHA) must be notified of intended asbestos abatement to be carried out. Asbestos abatement contractors must follow state regulations contained in 8CCR1529 and 8CCR341.6 through 341.14 where there is asbestos-related work involving 100 square feet or more of asbestos containing material. Asbestos removal contractors must be certified as such by the Contractors Licensing Board of the State of California. The owner of the property where abatement is to occur must have a Hazardous Waste Generator Number assigned by and registered with the Office of the California Department of Health Services in Sacramento. The contractor and hauler of the material is required to file a Hazardous Waste Manifest which details the hauling of the material from the site and the disposal of it. Pursuant to California law, the Department of Building Inspection (DBI) would not issue the required permit until the applicant has complied with the notice requirements described above. *(Required by Law)*

b. Lead-Containing Materials

If the building survey finds lead-containing materials at the Fleishhacker Bath House, the contractor would be required to comply with applicable federal, state and local requirements, including OSHA, Cal/OSHA, and BAAQMD regulations as well as the City's Hazard Materials Ordinance, for removal or abatement of lead-based paint and lead dust. *(Required by Law)*

c. Other Hazardous Materials

If the building finds other hazardous materials, such as mercury-containing fluorescent light tubes, PCB-containing light ballasts, or underground storage tanks, then the contractor would be required to comply with applicable federal, state and local requirements, including OSHA, Cal/OSHA and other environmental

regulations prior to and during the demolition of the building and disposal of building materials and debris. *(Required by Law)*

F-12. The Project Sponsor would require that a site investigation be conducted at the Lincoln High School site to evaluate the potential presence of chemicals in the soils due to industrial-type storage containers that were identified in the 1938 aerial photograph. The site investigation would focus on the area where the storage containers were identified where excavation is proposed and would include the installation of shallow soil borings with analysis of soil samples for the chemicals that could be present. If hazardous materials are identified in the soil samples, the regulatory agencies would be notified and additional site characterization and remediation, if necessary, would be conducted in accordance with applicable local, state, and federal regulations. *(Actions described above if hazardous materials are identified in soil samples are Required by Law.)*

F-13. The Project Sponsor would obtain a permit to install an underground storage tank for the back up generator for the RWTP and the Lincoln High School pump station, and would implement an approved monitoring plan to reduce the potential for undetected leaks from the UST. *(Required by Law)*

Construction Phase

F-14. Prior to construction dewatering at the Fleishhacker Pool site, the Project Sponsor would require the construction contractor to perform a hydrologic assessment to evaluate whether dewatering at the Fleishhacker Pool site could accelerate contaminant migration in the groundwater from the former Chevron service station even though remediation has been completed at this site. The Project Sponsor would require the contractor to prepare a contingency plan in the event that petroleum hydrocarbons are identified in the groundwater during dewatering activities. In addition, the owner of the property where the former Chevron service station was located and the SFDPH would be notified prior to conducting any dewatering at the Fleishhacker Pool site. Monitoring wells would be installed as determined necessary by the hydrologic assessment.

If it is determined that there is the possibility of accelerating the plume migration, the contractor would be required to take any necessary steps to prevent such migration, such as the following: monitoring of groundwater quality and levels, before, during and after construction dewatering activities; reducing the rate of dewatering; or if necessary, temporarily ceasing pumping. To monitor for the potential migration of dissolved contaminants during dewatering at the Fleishhacker site, the Project Sponsor would require periodic sampling of groundwater monitoring wells located downgradient from the former service station site. If evidence of contaminant migration is detected in the monitoring wells during the dewatering activities, dewatering would be immediately stopped and the property owner and SFDPH would be notified. The Project Sponsor would coordinate with SFDPH to determine if additional remediation efforts, such as groundwater extraction, would be required at the former service station site in order to proceed with any additional dewatering activities necessary for RWTP construction.

Groundwater brought to the surface as a result of construction dewatering would be contained and tested prior to disposal. Quality of the discharge must meet requirements of the San Francisco Industrial Waste Ordinance for disposal to the sewer system or must be approved by the RWQCB for discharge to surface waters such as the ocean. At a minimum, temporary containment would allow suspended solids to settle out before disposal. If quality of the discharge does not meet the requirements for sewer disposal, the dewatering water could be treated on-site or disposed of to an acceptable off-site facility.

Operation Phase

F-15. The RWTP would have a Hazardous Materials Management Plan on file to address the handling and storage of all hazardous materials used on site, including sodium hypochlorite, alum, polymer, phosphoric acid, caustic soda, and sodium hydroxide. Depending on the volumes involved, the preparation of a risk management prevention plan may be completed. *(Required by Law)*

Measures Proposed as Part of the Project - GWMP Only

Planning and Design Phase

F-16. The proposed wellhead protection program would be initiated in the Sunset District area in the vicinity of the proposed production wells. This would include delineation of a wellhead protection area, identification of potential contaminant sources, analysis of potential contaminant travel time, development and implementation of a groundwater quality sampling and monitoring program. Regulatory data bases would periodically be reviewed by the Project Sponsor to identify potential contamination sources in the wellhead protection area.

F-17. Access to disinfection stations would be restricted through use of safety signs and locked fencing. Where tanks are located in schools, tanks would be refilled when the school is not in session. Additional hazardous material usage of disinfectant treatment chemicals at the chlorination stations would utilize chemical metering pumps with a magnetic type flow meter for monitoring the station water output. At chlorination stations, all sodium hypochlorite tanks would be bolted to the floor or strapped to the walls of stations, with flexible piping connections between tanks, pumps and injection points.

Measures Under Consideration - GWMP Only

Operation Phase

F-18. To avoid potential water quality impacts to the AWSS system, groundwater would be monitored at the Powell Street BART Station facilities for potential contamination from identified contamination sources in the vicinity. Monitoring should continue until identified hazardous materials sites have been remediated to the satisfaction of the RWQCB and other regulatory agencies with jurisdiction.

G. TRAFFIC AND CIRCULATION

Traffic Regulations

The City and County of San Francisco has established specifications for traffic routing in construction areas. Work performed on city streets is required to have traffic routing that includes mitigation measures to maintain traffic flow to the extent possible. Among the issues that the mitigation measures should address are:

- Emergency access
- Street closures
- Temporary travel lane closures
- Maintaining access to adjacent residential and commercial property
- Construction periods
- Removal of on-street parking
- Temporary traffic striping and traffic signals
- Off-duty Parking Control Officers to control traffic movements

Measures Proposed as Part of the Project - Both RWMP and GWMP

Planning and Design Phase

G-1. After selection of final pipeline routes, a Transportation Management Plan would be prepared, subject to approval by the City's Department of Parking and Traffic (DPT) to detail specific roadway construction information; haul routes; specific data on pipeline alignments within each street as determined during the design phase; prohibition of truck traffic during a.m. and p.m. peak traffic periods; signing for closures; and public notification identifying location, scheduling, and duration of construction period.

The Management Plan would also include necessary Traffic Routing Plans for specific locations which may be affected by construction. The Management Plan would address the specific requirements for traffic control, including construction timing for specific areas and traffic detours.

Construction Phase

G-2. On roadways where trenching occurs within the roadway right-of-way, one travel lane would be left open in each direction where feasible, and delineated by temporary traffic cones/barricades. For minor collectors and neighborhood streets, one lane would be left open with flagpersons controlling both directions of traffic, or the streets would be made temporarily one-way.

G-3. Construction work on major roadways and through major signalized intersections would be conducted during off-peak traffic periods (the hours outside of 7:00 a.m. to 9:00 a.m., and 4:00 p.m. to 6:00 p.m.) to alleviate traffic impacts. Construction within a major intersection would be restricted to only half of an intersection at any one time in order to maintain traffic flows.

G-4. Construction trenches would not be left open after work hours, and would be covered by steel plates to allow access to private and commercial driveways. For the safety of bicyclists, asphalt would be placed around edges of steel plates to secure them and to eliminate abrupt edges.

G-5. Private driveways located within construction areas would be kept open to maintain access to the maximum extent feasible. If it is anticipated that a trench would be open in front of a private driveway for five days, metal plates would be used to provide 24-hour access, except for up to three hours of blockage as needed during construction.

G-6. To minimize cumulative traffic impacts due to lane closures during construction, the Project Sponsors would require that the project construction contractor coordinate with

construction contractor(s) for any concurrent nearby projects that are planned for construction.

G-7. All City fire, police, and paramedic departments would be notified regarding the schedule and duration of construction activities. Alternative routes would be identified that may be used to avoid construction areas.

G-8. To the extent possible, existing MUNI bus routing and bus stop locations would be maintained during construction. If routes must be diverted to a parallel street, adequate notices and signing would be installed to direct patrons to the temporary routing. Bus stop locations may be temporarily relocated, with notices or signs to direct patrons.

Measures Proposed as Part of the Project - RWMP Only

None required.

Measures Proposed as Part of the Project - GWMP Only

None required.

H. AIR QUALITY

Measures Proposed as Part of the Project - Both RWMP and GWMP

Construction Phase

H-1. Dust control measures would be implemented by contractors of proposed facilities as follows:

a. Continuous dust suppression using non-potable water would be employed during all dust-generating construction activities such as: pavement cutting, drilling on rock, excavating, excess soils loading, and hauling, and temporary stockpiling. Areas where breaking of raw ground is to occur would be watered down before grading commences.

b. At least twice a day, and more frequently on dry or windy days, all areas of the construction site that could potentially generate wind-borne materials would be wet down.

c. Soil stockpiles to be left unattended for more than 24 hours (such as weekends and holidays) would be covered with tarps and watered down with a temporary sprinkler system, to control dust emissions. Tarps would be secured and weighted so as to prevent them from being blown off. Soil binders would be used on stockpiles to be left unattended for longer periods. If soil binders are to be used, they would be stored on-site at all times during construction to ensure availability when the need arises. If left unattended for prolonged periods (months), stockpiles could be hydroseeded.

d. A berm of sandbags or other material would be placed along the edge of all stockpiles to keep dirt clods from rolling into traveled lanes and being pulverized by passing vehicles.

e. The street areas adjacent to the construction site would be mechanically swept (preferably by vacuum sweepers) and washed down daily at the end of the workday.

f. Material delivered or removed from the construction site that could generate dust would be covered at all times. Haul trucks would not be overfilled and loads would be covered with tarpaulins.

g. To minimize dust emissions during high wind conditions, all earth-moving activities would be halted when winds exceed 20 miles per hour. If this measure is not feasible, the contractor should be required to prepare a dust control plan for high wind periods and for the weekend including watering of haul roads with dust suppressant when winds are over 20 mph, using additional trucks to ensure that continuous watering can be provided and exposed areas do not dry out, and using sprinklers on particular problem areas.

h. If there are any unpaved roads which are to be used by haul trucks on a regular basis for access to the construction areas, these roads should be watered down frequently to minimize dust generation, and possibly, depending on the site, covered with gravel or other materials prior to their use. (Gravel roads generate less dust than dirt or unpaved roads). This condition would most likely occur only at the RWTP or McLaren sites under the RWMP, but could apply to GWMP sites depending on final facility locations.

i. The Environmental Compliance Monitoring Program should include dust monitoring (total dust and PM_{10}) as a quantitative means for documenting air quality conditions in the site vicinity. However, due to the delay in obtaining laboratory analysis results, compliance should also be determined on a daily basis by visual site inspection to check for adequate watering and use of soil binders on any extensive inactive graded areas and covered stockpiles. Real-time monitoring, such as use of spectrophotometers, at sensitive receptors should be used where regulation of PM_{10} is a critical issue. The monitoring program should include a PM_{10} action level which would be determined based on background PM_{10} levels which would be measured prior to start of construction.

H-2. Any stationary motor sources (such as generators and compressors) to be located within 100 feet of any residence or school (sensitive receptors) for the duration of construction would be equipped with a supplementary pollution control system on its exhaust as required by Bay Area Air Quality Management District (BAAQMD) and California Air Resources Board (CARB).

H-3. Site safety plans for work in serpentinite rock would be developed for construction of project facilities to ensure protection of worker health and safety with respect to potential exposure to asbestos in the event serpentinite rock is encountered. A trained inspector would be present on-site to identify the presence of serpentinite rock, which if present, would require air monitoring of asbestos fibers for on-site workers. If air monitoring indicates that airborne concentrations of asbestos fibers exceed the CAL/OSHA action level, then additional dust mitigation measures must be implemented immediately. These measures could include the following:

a. A continuous water misting operation using a spray nozzle adjusted to provide as fine a mist as possible would be applied in the immediate serpentine excavation and drilling operation areas.

b. The amount of excavated serpentine soils stored on site would be minimized to the extent possible. Soils stockpiled containing serpentine would be kept wet and covered with a 10-mil polyethylene plastic layer until they are properly disposed of in a landfill.

c. Haul trucks carrying serpentine would be loaded so that the material does not extend above the walls and back of the truck bed. The surface of all serpentine loads would be thoroughly wetted and then tightly covered before the haul trucks leave the loading area.

d. Travel over exposed serpentine areas would be restricted to only that necessary for excavation, drilling, and off-hauling operations. In the event of a spill, material would be contained by mechanical sweeping or other appropriate methods.

e. Workers would be required to comply with CAL/OSHA requirements for use of respiratory equipment. Workers implementing dust control measures, such as watering soil or rock surfaces, could be required to wear respiratory equipment.

Measures Proposed as Part of the Project - RWMP Only

Construction Phase

H-4. If construction activities at the RWTP and Lincoln High School sites result in haul trucks being scheduled for use at both sites during the same time period, contractors at both sites would be required to utilize equipment with recent (within 30 days) low-NO_x tune-ups to minimize NO_x emissions. This would apply to all diesel-powered equipment greater than 50 horsepower and periodic tune-up (every 90 days) would be required for equipment used continuously at the sites.

Measures Proposed as Part of the Project - GWMP Only

None required.

I. NOISE AND VIBRATION

Measures Proposed as Part of the Project - Both RWMP and GWMP

Construction Phase

I-1. Equipment and trucks used for project construction would be required to utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of silencers, shields, shrouds, ducts, and engine enclosures) in order to minimize construction noise impacts. At the initial phase of construction, the Project Sponsor would require that all construction equipment (except for impact tools, pavement breakers and jackhammers) be tested to ensure that equipment noise does not exceed 80-dBA at 100 feet (as specified in Section 2907 of Article 29, Police Code). New equipment as required would also be

tested for noise compliance prior to use on the site. In addition, periodic monitoring of noise at the construction sites would be included in the Environmental Compliance Monitoring Program to ensure that the equipment remains in compliance with the City noise standard (at a minimum, once every six months).

I-2. Residents living adjacent to construction sites or along construction routes would be notified of construction scheduling in their vicinity as specifically as possible in terms of times, dates, and location of construction activities.

I-3. All construction activities would be limited to the daytime working hours (7 a.m. to 5 p.m., weekdays only) in all project construction areas, with two possible exceptions: at the Lincoln High School reservoir site where construction could also occur on Saturdays (8 a.m. to 4 p.m.) and on major roadways and major signalized intersections where construction would be conducted during off-peak traffic periods (9 a.m. to 4 p.m., see Measure G-3). These working hour restrictions would also apply to haul and delivery trucks, and would generally include employee trucks and vehicles driving to and from the site during this time period.

I-4. Haul trucks would be prohibited during the nighttime hours (8 p.m. to 7 a.m., pursuant to Section 2901, Article 29, Regulation of Noise) to minimize noise impacts on residents living along haul routes. To the extent practicable, final haul and truck routes would avoid schools. Wherever possible, routes would attempt to avoid residential streets. Travel speeds for haul trucks in residential and school areas should be maintained at 25 mph or less and enforced through the Environmental Compliance Monitoring Program (or City Police Department if necessary). Use of haul trucks at the Lincoln High School site on Saturdays would be minimized to the extent feasible.

I-5. Hydraulically or electrically powered impact tools (e.g., jack hammers, pavement breakers, and rock drills) would be used wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatically powered tools is unavoidable, an exhaust muffler on the compressed air exhaust would be used; this muffler can lower noise levels from the exhaust by about 10-dBA. External jackets on the tools themselves would be used where feasible, and this could achieve a reduction of 5-dBA.[1]

I-6. Hospital grade mufflers would be installed on all stationary noise sources located within 200 feet of any sensitive noise receptors (e.g., residences, schools, and zoos). Stationary noise sources would comply with City noise standards and would be located as far from adjacent or nearby sensitive receptors as possible. If they must be located near existing receptors (closer than 200 feet), they would be contained within temporary enclosures.

I-7. There would be a designated Complaint Coordinator responsible for responding to noise complaints received during the construction phase. The name and phone number of the complaint coordinator would be conspicuously posted at construction areas and listed in scheduling information. This person would be responsible for taking steps required to resolve complaints, including periodic noise monitoring if necessary.

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[1] US Environmental Protection Agency, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances,* December 1971.

I-8. Construction activities adjacent to any schools (including Lincoln High School and Francis Scott Key School) would be coordinated with the school schedules so that the noisier phases of construction (particularly excavation, shoring, and pile driving) occur when schools are not in session (e.g., during summer vacation). If school is in session when construction occurs, interior noise levels within the school buildings would be maintained below 60-dBA or at the existing ambient level (when classes are in session) during construction to ensure that interference with speech does not occur (vibratory pile drivers or pre-drilled soldier piles would be required to maintain this noise level). In addition, project excavation/shoring activities (including sheetpile driving, if necessary) should be coordinated with the school's use of the adjacent basketball courts and fields, and if necessary, plywood barriers would be constructed at the project boundary to allow continued use of these facilities by the school during project construction.

I-9. All soldier piles would be pre-drilled wherever feasible to reduce construction-related noise and vibration. No impact pile drivers would be used unless absolutely necessary. This should be specified as part of construction requirements of all project facilities except at the RWTP site. Due to this site's proximity to the Zoo animal collection, use of jackhammers and impact pile drivers would be prohibited at the RWTP site.

I-10. To reduce noise impacts, sonic or vibratory sheetpile drivers, rather than impact drivers would be used for cut-and-cover (pipeline) construction. At the reservoir sites, pre-drilled soldier piles and lagging would be used to support excavated areas. Shoring requirements for each project component should be specified as part of the project design, and construction requirements of all project facilities should specify avoiding use of impact drivers.

I-11. For all project facilities, contractors would be required to use construction techniques that minimize vibration levels, particularly during construction in proximity to sensitive receptors. With respect to sheetpile driving, the trench would be excavated as sheetpile driving progresses. Other measures may include: pushing the sheetpile in as far as possible with the excavator CAT before using the vibrator; using a smaller, hand-operated vibratory hammer or one with a different operational frequency to further reduce the vibration potential; flooding the soils before tamping with the vibrator; and/or operating the vibratory CAT with "throttling" when a vibrator must be used. Vibration generated during soil compaction may also be minimized by using a small compactor. The goal for both sheetpile driving and soil compaction would be to put less vibratory energy into the surrounding ground while at the same time accomplishing the job. It may be possible to use smaller equipment even though this would take longer to complete the work.[2] The Environmental Compliance Monitoring Program should monitor effectiveness of the various techniques used to minimize vibration, and the contractors specifications should require the contractor to use construction methods that minimize vibration during construction in proximity to sensitive receptors.

I-12. A vibration monitoring program would be developed for all cut-and-cover construction where sheetpile driving is proposed. This program should be developed as part of the Environmental Compliance Monitoring Program, after pipeline routes have been determined. The program should include documenting potential vibration impacts by performing pre-construction surveys at all structures along the construction route to note the existing condition of structures. Results would be compared to post-construction surveys. Inspectors would be present during construction activities, and complaints received during construction activities would be investigated. Vibration should be

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[2] Wilson, Ihrig & Associates, *Weekly Progress Report for Vibration Monitoring for Richmond Transport ECM (8/9 to 8/11/94),* August 12, 1994.

measured at representative locations along the pipeline route to ensure that vibration levels do not exceed 0.10 in/sec (peak particle velocity or PPV) at adjacent structures and 0.126 in/sec (PPV) at the Zoo.[3,4]

I-13. During final design of project facilities, as part of the Environmental Compliance Monitoring Program, background noise measurements would be taken at the property lines of the nearest sensitive receptors to sites where project components would have the potential to generate noise (where facilities include pumps, blowers, fans, generators, etc.). After completion of these project components, noise measurements would be taken at the same locations when the facilities are operating to ensure that operational noise increases do not exceed the 5-dBA limit specified in the Police Code. The performance standard would be established based on these noise measurements and would be 5-dBA above the background ambient pre-project level.

Noise measurements would also include an analysis of the spectral character of baseline and project operational noise to reduce the potential for annoyance due to generation of higher frequency noise occurring under baseline or background conditions. These analyses should be conducted prior to commencement of project construction (when baseline noise data are being collected as part of the Environmental Compliance Monitoring Program) and after completion of the project when it is in operation.

I-14. Enclosures for all project-related noise sources (e.g., pumps, blowers, fans, emergency generators) would be designed to provide maximum noise attenuation to maintain existing noise levels to the extent feasible, or at a minimum, meet the performance standard specified in Measure I-13, above. Such measures could include: installation of acoustical louvers or mesh grilles on all openings to buildings which house pumps, blowers, generators, or other noise-generating equipment; use of masonry building materials for maximum noise attenuation; and location of vent openings on the sides of enclosures away from sensitive receptors. Acoustical design features should be specified prior to approval of project plans.

Measures Proposed as Part of the Project - RWMP Only

Construction Phase

I-15. A sound wall would be provided along the RWTP site boundary to protect Zoo animals, particularly the Children's Zoo and Gorilla World, from construction noise. This wall would be constructed to achieve a 10-dBA noise reduction during construction. It is likely that the temporary sound wall being constructed for the Zoo Infrastructure Project could be used for this purpose. Alternatively, if possible, this wall could be designed and constructed as part of the proposed future Zoo entry design. If the scheduling of either of these walls does not coincide with RWTP construction, a temporary double plywood wall (with 2 x 4's in between the two plywood walls, and 3/4" plywood insulation if necessary) would be constructed along the site boundary in the interim period. The sound wall would maintain the ambient noise levels at the site boundary to within the 5-dBA (Leq) and 10-dBA (Lmax) noise increase criteria. Wall height should exceed the maximum stack height of construction equipment to be used at the RWTP site. Wall locations and extent would

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[3] A criterion of 0.10 in/sec was implemented in contract specifications for tunnel blasting for the Richmond Transport project and monitoring data for that project indicated that the level of annoyance was tolerable to most residents for vibration levels of less than 0.1 in/sec (i.e., when no complaints were received).

[4] The vibration standard set for protection of zoo animals during construction of the Oceanside Water Pollution Control Plant.

be determined, in consultation with Zoo staff, once detailed site plans and facility locations are determined.

In addition, the contractors would be required to proceed with construction in such a way as to habituate sensitive animals to construction noise and vibration, as during construction of the Oceanside Plant and as is currently being implemented for the Zoo Infrastructure Plan projects.[5,6] When a construction activity is anticipated that could cause violation of noise criteria, Zoo staff would be notified in advance of the activity, and noise levels and animal behavior would be monitored at sensitive sites in the Zoo nearby the construction site (Gorilla World and Children's Zoo). Any animal behavioral changes in response to construction noise and vibration would be noted. If construction noise and vibration are observed to cause behavioral changes of concern, the City would consult the Zoo staff, and construction could be halted until animals can be relocated to an area at a distance from construction activity, or acclimated to the noise and vibration more gradually.

I-16. If a reservoir is constructed at McLaren Park Site 2, construction activities would be coordinated with any scheduled weekday amphitheater/park events to ensure noise compatibility problems with park uses do not arise.

Measures Proposed as Part of the Project - GWMP Only

None required.

J. BIOLOGICAL RESOURCES

Measures Proposed as Part of the Project - Both RWMP and GWMP

None required.

Measures Proposed as Part of the Project - RWMP Only

Planning and Design Phase

J-1. All reservoirs would be located below the existing ground elevation to the maximum extent possible to allow for re-establishment of recreation and park uses after the reservoirs are completed.

J-2. Landscape plans for all reservoir sites would utilize trees that are large enough (in the opinion of the Recreation and Park Department staff) to rapidly begin growth in place. Trees would be replaced at a ratio of 3 to 1. Native coast live oak (*Quercus agrifolia*) trees would be considered in place of the Monterey pine and cypress, and all trees removed would be replaced with native species such as coast live oak. For replacement shrubs, the California Native Plant Society (CNPS) recommends various species of ceanothus and

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5 City and County of San Francisco, Department of City Planning, *Southwest Sewage Treatment Facilities FEIR,* March 10, 1988.

6 City and County of San Francisco, Planning Department, *Negative Declaration, San Francisco Zoo Infrastructure Replacement,* December 22, 1994.

manzanita native to the coast of California, as well as coyote brush.[7] The Recreation and Park Department would be consulted for the landscape plan for McLaren Park, and the School District would be consulted for the landscape plan at Lincoln High School.

J-3. Landscape plans for any exposed areas on existing or planned berms at the RWTP site would emphasize use of native California dune plants (such as prostrate coyote brush (*Baccharis pilularis*) and other species of the Franciscan Coastal Scrub) as recommended by the Recreation and Park Department and CNPS. Appropriate dune species raised from local seed sources would be utilized, rather than with non-native weedy species.[8]

Construction Phase

J-4. At the Lincoln High School Reservoir site and McCoppin Square Park staging area, as soon as construction of the reservoir is completed, the topsoil would be returned to the finished grade and reseeded with turf grass.

J-5. At the McLaren Park Reservoir site, the topsoil would be returned to the finished grade and reseeded with native annual and perennial grasses and native herbaceous plants.

J-6. To prevent damage to any trees that are proposed to be retained but which are located adjacent to reservoir sites or within/adjacent to staging areas (particularly the McCoppin Square Park staging area), the contractors would be required to implement the following measures:

a. The driplines of trees to be retained would be delineated on project plans.

b. Temporary chain link or wood fencing would be erected around the base of trees to be retained.

c. No grading or heavy equipment operation would occur within the protected zone around the bases of trees to be retained to avoid soil compaction. Cuts or fills within the driplines of trees to be retained would not exceed six inches.

d. Trenching for utility lines would also be excluded from the dripline area of trees to be retained. If trenching is unavoidable, it would be performed manually and without the use of heavy equipment.

e. Any trees that are damaged would be replaced at a ratio of 3 to 1, and replacement trees would be large enough to rapidly begin growth in place. Damaged trees would be replaced with native species such as coast live oak.

J-7. Although there is only a remote possibility that the Monarch butterfly would occur at either the reservoir site at Lincoln High School/McCoppin Square (staging area) or McLaren Park, the City would conduct a site survey by a qualified biologist during the winter season prior to proposed construction start-up to verify that the butterflies still do not use these sites as an overwintering roost. If Monarch butterflies are found to be using a site for an overwintering roost, a qualified biologist would be consulted to determine if construction can proceed as scheduled without disrupting the roost or if the construction

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7 Smith, Susan, California, Native Plant Society, Rare Plant Committee. Personal communication with Kathy Cuneo, Environmental Science Associates, March 6, 1995.

8 ibid.

schedule must be adjusted to avoid the roosting period (typically December through March). The City would adjust its construction schedule accordingly.

Operation Phase

J-8. At all reservoir sites, trees would be watered, fertilized, and monitored for a period of two years. During the two-year monitoring period, all trees that do not survive would be removed and replaced.

J-9. The SFWD would provide information to irrigation users of recycled water regarding the water quality and landscape management concerns associated with use of recycled water. In particular, irrigation users would be notified of nitrate and other nutrient data in the recycled water so they can manage fertilizer application accordingly. Irrigation users would also be informed of pH and corrosion potential of the recycled water so that users can make appropriate adjustments to reduce potential corrosive effects to irrigation system pipelines. In addition, the SFWD would provide back-up water supply systems for all recycled water users in the event of a recycled water system upset.

Measures Proposed as Part of the Project - GWMP Only

J-10 The City would re-landscape the open space area disturbed during construction of the Elk Glen Well and pipeline after construction completion, in consultation with the Recreation and Park Department.

K. CULTURAL RESOURCES

Measures Proposed as Part of the Project - Both RWMP and GWMP

Construction Phase

K-1. The City would retain the services of a qualified archaeologist. The Environmental Review Officer (ERO) in consultation with the President of the Landmarks Preservation Advisory Board (LPAB) and the archaeologist would determine whether the archaeologist shall instruct all excavation and foundation crews associated with RWMP and GWMP projects of the potential for discovery of cultural and historic artifacts, and the procedures to be followed if such artifacts are uncovered.

K-2. Should evidence of cultural or historic artifacts of significance be found during project excavations, the ERO and the President of the LPAB would be notified immediately and excavation which could damage such artifacts would be halted. The archaeologist would assist the Office of Environmental Review in assessing the significance of the find and determining whether feasible measures, including appropriate security measures, could be implemented to preserve or recover such artifacts. Excavation or construction that might damage the discovered cultural resources would be suspended for a maximum of four weeks (cumulatively for all instances that the ERO has required a delay in excavation or construction) to permit inspection, recommendation and retrieval, if appropriate.

The archaeologist would prepare a draft report containing an assessment of the potential significance of the find and recommendations for what measures should be implemented to minimize potential effects on archaeological resources. Based on this report, the ERO

would recommend specific additional mitigation measures to be implemented by the Project Sponsors. Mitigation measures might include a site security program, additional on-site investigations by the archaeologist, and/or documentation, preservation, and recovery of cultural materials. Finally, the archaeologist would prepare a draft report documenting the cultural resources that were discovered, an evaluation as to their significance, and a description as to how any archaeological testing, exploration and/or recovery program was conducted.

Copies of the draft reports prepared according to these mitigation measures would be sent first and directly to the ERO and to the President of the LPAB for review. Following approval of the report by the ERO and the President of LPAB, a final report is to be sent to the Northwest Information Center at Sonoma State University, the Foundation for San Francisco's Architectural Heritage and the State Office of Historic Preservation. The Office of Environmental Review shall receive three final copies of the final archaeological findings report.

Measures Proposed as Part of the Project - RWMP Only

None required.

Measures Proposed as Part of the Project - GWMP Only

None required.

L. ENERGY AND NATURAL RESOURCES

Measures Proposed as Part of the Project - Both RWMP and GWMP

None required.

Measures Proposed as Part of the Project - RWMP Only

None required.

Measures Proposed as Part of the Project - GWMP Only

None required.

OTHER TOPICS REQUIRED BY CEQA

CHAPTER VIII
OTHER TOPICS REQUIRED BY CEQA

SIGNIFICANT ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED IF THE PROPOSED PROJECT IS IMPLEMENTED

In accordance with Section 21083 of the California Environmental Quality Act (CEQA), and with Sections 15064 and 15065 of the State CEQA Guidelines, the purpose of this section is to identify impacts that could not be eliminated or reduced to an insignificant level by mitigation measures included as part of the proposed project, or by other mitigation measures that could be implemented, as described in Chapter VII (pp. 472 to 498).

The findings of significant impact are subject to determination by the City Planning Commission as part of its determination process for the EIR. This section in the Final EIR will be revised, if necessary, to reflect the City Planning Commission's findings.

Implementation of the RWMP or the GWMP as well as the projects currently proposed in the plans would not result in any significant unavoidable adverse impacts. Impacts of the projects are discussed in Section V (pp. 251 to 434), and all identified impacts are mitigated to less-than-significant levels or substantially lessened.

RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

According to CEQA *Guidelines* Section 15126(e), the purpose of this section is to "describe the cumulative and long-term effects of the proposed project which adversely affect the state of the environment. Special attention should be given to impacts that narrow the range of beneficial uses of the environment or pose long-term risks to health or safety. In addition, the reasons why the proposed project is believed by the sponsor to be justified now, rather than reserving an option for further alternatives, should be explained."

Implementation of the RWMP and GWMP would result in development of various facilities as described and analyzed in this document. Construction of the RWMP and GWMP facilities would result in short-term, temporary environmental impacts related to increased truck and worker traffic as well as increased noise and air emissions. Potential environmental impacts associated with the construction of the project are discussed in Section V under Transportation,

Noise and Air Quality (RWMP, pp. 314-362; GWMP, pp. 418-429). Since construction impacts would be temporary, they would not result in any significant long-term effects. Mitigation measures are included in the project to minimize the potential environmental effects of construction.

Implementation of the RWMP and GWMP would increase the efficiency and coordination of the region's water use, thereby increasing the range and degree of beneficial use gained from the available water resources. Maximizing efficiency and coordination of water use and protecting beneficial uses would contribute to the long-term productivity of the region.

RWMP implementation would not pose long-term risks to public health or safety. Federal and state regulations have established criteria for treatment, quality, distribution and use of recycled water, designed to protect the public health. The recycled water system under the RWMP would comply with these regulatory requirements; use of recycled water for the proposed functions would not threaten public health or safety. In addition, the RWMP projects would increase the storage and distribution area of the City's AWSS, thereby increasing the reliability and range of the City's fire fighting system. The proposed RWMP projects would therefore increase protection of public safety.

GWMP implementation would not threaten public health or safety. Groundwater well construction, maintenance and use that would be associated with the GWMP would comply with relevant regulations regarding well construction and maintenance, as well as with those regarding drinking water quality. See Section V.B.3, Water Quality/Public Health (pp. 401-407), for further discussion of the proposed project's protection of public health.

SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

The California Environmental Quality Act (CEQA) states that impacts associated with a proposed project development may be considered to be significant and irreversible if:

- The project would involve a large commitment of non-renewable resources.
- The primary and secondary impacts of a project would generally commit future generations to similar uses (such as a highway improvement that provides access to a previously inaccessible area).

- The project involves uses in which irreversible damage could result from potential environmental accidents associated with the project.

RWMP and GWMP implementation as well as construction of RWMP and GWMP project facilities would result in an irretrievable and irreversible commitment of natural resources through direct consumption of fossil fuels and through use of materials primarily during construction. Operation of the recycled water treatment plant, wells and pump stations proposed under the RWMP and GWMP would use City power sources, which relies on hydro-electric power rather than fossil fuels.

In addition, both the RWMP and GWMP would result in irreversible, long term uses of underground areas for construction of the reservoirs, portions of the RWTP, and well facilities. However, the above ground uses in these areas would in most part be restored to existing recreational and school uses, with the major exception of about 25,000 square feet of City property for the above-ground portions of the RWTP which would be committed to public works use. This would result in intensification of land uses within existing open space in a developed urban area.

Implementation of the RWMP and GWMP would not commit future generations to undesirable uses. RWMP and GWMP projects would increase the efficiency and coordination of use of water resources in the long-term.

The project would not involve uses that could involve accidents that could cause irreversible damage. Operation of RWMP recycled water treatment plant and GWMP well disinfection stations would require storage, transport and use of various chemicals.

Implementation of the RWMP would not involve any irreversible changes to groundwater or surface water resources. While implementation of the GWMP would involve installation of wells which could affect the groundwater basin and system, the benefits to the groundwater resources associated with the management and monitoring strategies of the GWMP would be considered to offset these potential adverse changes.

ALTERNATIVES TO THE PROPOSED PROJECT

CHAPTER IX
ALTERNATIVES TO THE PROPOSED PROJECT

A. INTRODUCTION

This chapter identifies alternatives to the proposed project, discusses environmental impacts associated with each alternative, and gives the sponsor's reasons for rejection in favor of the project. Regardless of the sponsor's reasons for rejection, the City Planning Commission could approve an alternative instead of the project if the Commission believed the alternative would be more appropriate.

Section 15126(d) of CEQA states that the EIR should "describe a range of reasonable alternatives to the project, or to the location of the project, which could feasibly attain the basic objectives of the project, and evaluate the comparative merits of the alternatives." The basic objectives of the RWMP and the GWMP are presented below in order to facilitate comparison of the relative merits of the alternatives. As discussed in Chapter II (see p. 11), the shared objectives of both the RWMP and the GWMP are to:

- Coordinate management and conservation of the City's water supply resources, including surface water, groundwater and recycled water;
- Improve water supply reliability for the City, particularly during drought periods;
- Improve reliability and expand the fire protection system within the City;
- Preserve the high quality Hetch Hetchy system water supply for potable uses; and
- Maximize the use of recycled water within the City at a reasonable cost.

The specific objectives of the GWMP, which are incorporated as goals in the GWMP (see pp. 81 to 88) are to:

- Protect and enhance groundwater quality;
- Coordinate groundwater use;
- Protect and conserve groundwater-related water resources;
- Improve ability to deliver water during emergencies; and
- Maximize groundwater use.

This chapter presents alternatives to the Recycled Water Master Plan (RWMP) and the Groundwater Master Plan (GWMP) both on a program level and on a project level. The program-level alternatives serve as alternatives to both plans, which in addition to the No Project Alternative (and variations), includes other conceptual programs that could in some sense achieve the shared objectives of improving efficiency of water resources and improving the reliability of the City's water supply. Due to the applicability of the plans to the City as a whole, there would be no alternative locations on a program-level, other than within the City proper. The project-level alternatives for the RWMP include variations on the overall system as well as alternative locations for the individual facility components. The GWMP has no project-level alternatives, since it is more of a conceptual plan, which includes options for future additional near-term activities rather than alternative projects.

B. PROGRAM ALTERNATIVES

This section addresses possible alternatives to the adoption and implementation of the overall RWMP and/or the GWMP that would achieve some or all of the shared program objectives of the two plans. These alternatives include the No Project Alternative, required by CEQA, even though by definition, this group of alternatives would not achieve any of the desired objectives. The other possible program alternative described is a Storage Alternative which could feasibly attain the objective of improving the water supply reliability. In addition, several alternatives were examined but determined to be infeasible either in terms of achieving any of the basic objectives of the two proposed plans or in terms of likelihood of being implemented. Alternatives examined in this category include water conservation, other sources of water supply, and additional storage alternatives.

NO PROJECT ALTERNATIVE

The No Project Alternative consists of some form of "no action" or "status quo" of current programs and policies. There are three variations on the No Project Alternative: (1) Implementation of neither the RWMP nor the GWMP; (2) Implementation of the RWMP but not the GWMP; and (3) Implementation of the GWMP but not the RWMP. None of these variations would achieve the shared objective of coordinating the management and conservation of the City's water supply resources. Any variation of the No Project Alternative would result in non-compliance with San Francisco Ordinances 390-91 and 391-91 and Board of Supervisors Resolutions 389-89 and 612-91 which require the development and implementation of these two plans. Under the No Project Alternative, the San Francisco Water Department (SFWD) would

not improve water supply reliability for its customers over current conditions; it would not have additional supply to meet water demands during drought periods or emergencies or projected future growth. During drought periods customers could expect supply reductions and rationing requirements of 25 percent or more as was required during the 1982-92 drought.

In addition, with or without recycled water and groundwater development, SFWD and other water suppliers serving the wholesale customers could be subject to further reduction of current water supply. Several regulatory and legal actions now in progress could change SFWD's water rights for consumptive use; these action include: The State Water Resources Control Board (SWRCB) development of a revised Water Quality Control Plan for the Bay-Delta; Endangered Species Act requirements for delta fisheries which affect State Water Project (SWP) and Central Valley Project (CVP) water deliveries, the proposed listing of steelhead trout as an endangered species, and legislative revisions to CVP operations. (See Section II.A, Background and Need for Plans, p. 7). Without implementation of the RWMP and GWMP, SFWD would not improve water supply reliability over current conditions, and it might not be able to maintain even current levels of reliability if water supply reductions occur. Therefore, the No Project Alternative variations would result in limiting the City's future capabilities in water resource planning and in meeting projected water demands.

Implementing Neither the RWMP Nor the GWMP

Under this No Project Alternative, neither the RWMP nor GWMP would be adopted and implemented. This would not meet the City's objectives to improve its water supply reliability, to maximize the efficient use of available water resources or to develop alternative water resources to augment the current SFWD supply. Further, the No Project Alternative would not comply with the explicit directives of the San Francisco Ordinances 390-91 and 391-91 which require the development and implementation of these two plans. Under this No Project Alternative, the City would have the same level of water supply reliability as the current level, with no additional resources to meet water demands during drought periods or during emergencies. Not implementing the RWMP would also be inconsistent with the objective to expand the City's fire protection and fire fighting capability by extending the high pressure, emergency auxiliary water supply system (AWSS) into the western and southeastern portions of the City. None of the specific objectives of the RWMP would be achieved, and none of the goals of the GWMP would be met beyond the existing level of groundwater management in the City.

No RWMP

Without adoption and implementation of the RWMP, impacts associated with construction of the proposed recycled water system of a tertiary treatment plant, three storage reservoirs and 28 miles of pipeline would be avoided. Neighborhoods where these facilities are proposed would not experience several months of construction disruption as these facilities are built (approximately 8-12 months for reservoirs; 24 months for the plant; and 2-4 weeks within a block of a given property for pipeline installation). During the construction, impacts that would be avoided include increased noise, dust, truck traffic, traffic congestion and access disruption, which would affect residential, park and school uses on and near the proposed sites.

At the RWTP site, the Zoo visitors, employees and animal collection would not be subject to noise, dust, truck traffic and overall disruption of the area and site during construction. The Fleishhacker Bath House would not be demolished for construction of the RWTP, and in the short term, the site could remain in use as an employee parking area and materials storage. In the long term, the Fleishhacker site would be available for surface and sub-surface development consistent with its designation for public uses and could be incorporated into the proposed Zoo Master Plan as part of the proposed new Entry Plaza and Parking Area, without the need to coordinate design and construction schedules with the RWTP.

At the reservoir sites, the high school students (Lincoln High) and park visitors (McCoppin Square Park and McLaren Park) would not experience short-term disruption of site use during facility construction, including temporary closure of Santiago Street between 22nd and 24th avenues. Under the RWMP, reservoir facilities would be buried and all surface uses would be restored; there would be no permanent displacement or restriction of land uses at these site, so the No Project Alternative represents no change from the proposed project with respect to long-term land use impacts at these sites. The Lincoln High School track and football stadium and the McLaren Park road, parking area, grassy areas, and pedestrian paths would all remain in their present condition.

Without building the additional pipeline proposed for recycled water storage and distribution system, the City would not expand the AWSS fire-fighting system into the western and southern areas of the City not now served with this emergency system. Without the proposed reservoirs, the southern and western areas of the City would not gain additional local emergency water supplies and would not have an emergency water system that could deliver high pressure water by gravity without the need for power. The low-pressure drinking water supply system that

serves these areas now does not provide the high-pressure water flow which is more effective for fire fighting. In areas where water is pumped through the distribution system, water supply is vulnerable to disruption in an emergency if the power fails. Residential areas at higher elevations, such as those surrounding McLaren Park, would not have an improved high-pressure emergency water supply which would improve fire response capability. The City could propose to expand the AWSS system as a separate project, not part of the RWMP; however, developing a distribution system with the dual purpose of fire fighting and recycled water supply would increase the benefit and, in effect, would reduce the cost to the public.

With continued use of imported potable water or groundwater for landscape irrigation rather than recycled water, landscape and park managers would not have to implement an increased level of irrigation management to comply with recycled water use requirements and to monitor and manage water quality effects such as potential build up of salts and other constituents. However, without recycled water, landscape and park irrigation with potable water could be restricted or prohibited during drought periods resulting in potential water stress effects on plants. Similarly, industrial or commercial users of recycled water would not have to construct additional treatment or distribution facilities or implement additional water quality management programs, but the same users, as well as the rest of the City, could be subject to tighter water restrictions during drought periods.

Under the No Project Alternative, the City would continue to use its imported potable water supplies once, to collect and treat the wastewater, and to then discharge the treated effluent to the ocean and bay. This would not be consistent with the California Water Code (Section 13512), which is to encourage development of water reclamation facilities, or with the policy of the Water Quality Control Plan for the San Francisco Bay Basin to support water reclamation. Without implementing the RWMP, the City would not have the opportunity to recover up to 10.3 mgd (11,500 ac-ft/yr) of its water resources for reuse. The City would continue to use potable water for non-potable uses. Without the RWMP, the City would not save up to 10.3 mgd of potable water and, as a result, it would not reduce the frequency or duration of the water shortages it now faces (and recently experienced) during drought periods due to the SFWD water supply deficits (see discussion in Chapter VI, p. 449).

No GWMP

Without adopting and implementing the GWMP, the City or private landowners could proceed with individual projects to install additional production wells, extract groundwater and increase

groundwater use, under the existing well permitting system. However, without the monitoring, studies, and management activities proposed as part of the GWMP, additional groundwater production could have long-term environmental effects such as extraction overdraft beyond the safe yield of the basin, increasing potential for saltwater intrusion, subsidence, water quality contamination, reduction of water supply in neighboring wells, or impact on surface waters such as Lake Merced and Lobos Creek. Although the City has already initiated discussions with Daly City, San Bruno and the California Water Service Company regarding in-lieu recharge, the absence of a GWMP would preclude the coordinated management of regional groundwater resources and hamper efforts to offset the declining water levels in Lake Merced. Although each groundwater well project would be evaluated for environmental effects prior to implementation, without a comprehensive and coordinated groundwater management program, it would be difficult to adequately monitor and address cumulative effects on groundwater resources. In addition, without implementing the GWMP, the City would not be in an effective position nor have the necessary tools to maximize efficient use of the groundwater resources or to manage surface and groundwater resource conjunctively.

Without implementation of the GWMP, the near-term activities associated with groundwater development and use at the Elk Glen Well, Sunset District well sites, and Powell Street BART Station would not occur. There would be no short-term disruption (approximately eight weeks) associated with construction of the wells, chlorination stations, pipelines, and pump facilities, and there would be no long-term displacement of portions of the playground area at the school sites in the Sunset District. In the long term, the SFWD would not be increasing its potable water supply to City customers by 1,000 ac-ft/yr from the proposed Elk Glen and Sunset District production wells, and the dewatering well at the Powell Street BART Station would continue to discharge about 150 ac-ft/yr of water to the sewer system, rather than contributing to the non-potable water supply for the AWSS. In addition, without the emergency supply wells proposed under Long-term Strategy 4A, the City would diminish its ability to protect its potable water supply in an emergency.

Implementing the RWMP But Not the GWMP

Implementing the RWMP alone would partially comply with San Francisco Ordinances 390-91 and 391-91, complying with respect to recycled water but not with respect to groundwater. The City would have an increased level of water supply reliability, based on the RWMP, to meet water demands during droughts and would also achieve the objective of increased reliability with respect to fire protection. By not addressing the groundwater resources, the City would not be

providing a coordinated level of management for its water supply resources, and therefore, would not be maximizing the efficient use of local water resources. None of the specific goals of the GWMP would be achieved beyond the existing level of groundwater management in the City.

Impacts associated with this variation of the No Project Alternative would be similar to the RWMP aspects of the proposed project (Section V.A, pp. 251-377) but would exclude those impacts identified with the GWMP (Section V.B, pp. 378-434). The effects associated with the absence of monitoring, studies and management activities, discussed above under *No GWMP* (p. 506), would occur, such as increasing the potential for overdraft, saltwater intrusion, subsidence, water quality contamination, and effects on Lake Merced and Lobos Creek. At the irrigation sites in the Westside Basin (i.e., Golden Gate Park and users near Lake Merced), both recycled water and groundwater would be available to users, but there would be no management structure to oversee or prioritize water use. It can be assumed that groundwater extractions for irrigation would be reduced relative to the amount that would occur pursuant to the GWMP, but it cannot be predicted at this time to what extent.

Without the GWMP, the proposed production wells at the Elk Glen Well site and the Sunset District sites may or may not be constructed, independent of any Citywide plan. If these wells are not constructed, there would be an overall decrease in groundwater pumping in the Westside Basin compared to the GWMP, although it can be expected that the existing Elk Glen irrigation well would continue to pump groundwater. However, installation of any or all of these wells could occur without the GWMP, and if they were installed, there would be no concurrent monitoring/modeling programs nor a saltwater intrusion prevention program to protect the groundwater quality of the overall Westside Basin. In fact, there would be no established long-term protection for the groundwater resources and associated surface water resources such as Lake Merced and Lobos Creek.

Implementing the GWMP But Not the RWMP

Implementing the GWMP alone would partially comply with San Francisco Ordinances 390-91 and 391-91, complying with respect to groundwater but not with respect to recycled water. The City would have an increased level of water supply reliability, based on the development and use activities in the GWMP, to offset some of the water demands during droughts, but this alternative would not achieve the objective of increased reliability with respect to fire protection nor would there be an expanded AWSS in the western and southern areas of the City. By not

addressing the potential for water reclamation, the City would not be providing a coordinated level of management for its water supply resources, and therefore, would not be maximizing the efficient use of local water resources.

Impacts associated with this variation of the No Project Alternative would be similar to the GWMP aspects of the proposed project (Section V.B, pp. 378-434) but would exclude those impacts identified with the RWMP (Section V.A, pp. 251-377). Groundwater development and use would be increased under the GWMP within the established management structure outlined in the GWMP. However, recycled water would not be available for non-potable uses and there could be increased demands for groundwater development to meet these already identified demands. In the Westside Basin, for example, recycled water would not be available to replace groundwater for irrigation at Golden Gate Park and the uses near Lake Merced. Current groundwater extraction levels would be expected to continue, in the short term, and in combination with proposed construction of new production wells in the Sunset District and the Elk Glen Well sites, there would be an increase in overall groundwater extraction similar to the proposed project. However, there may be reduced capability to operate the groundwater basins conjunctively, since recycled water would not be available to replace groundwater for irrigation water or other non-potable uses.

Overall, the No Project Alternative would fail to meet the City's objectives of coordinated management and conservation of the City's water supply resources, of increasing water supply reliability, and of promoting efficient use of water resources. No variation of the No Project Alternative would be the environmentally preferred alternative.

ADDITIONAL STORAGE FOR HETCH HETCHY WATER ALTERNATIVE

Overview

The SFWD might be able to increase water supply from the Hetch Hetchy system if it could develop additional storage facilities and increase the conveyance capacity of the system. The SFWD has rights to additional water through the Hetch Hetchy system, but currently it does not have the capacity to transport or store additional amounts of water. To increase surface water supply, additional storage capacity is required to reserve water from wet years for use in dry years.

Surface Storage

Additional storage could possibly be provided in either new or expanded surface water reservoirs or in groundwater basins. There is limited potential for development of additional surface water storage capacity. Use of active gravel quarries, once mining is complete, in the Sunol area of Alameda County is one feasible surface storage alternative. Other surface storage options, such as increasing capacity of existing Hetch Hetchy reservoirs or construction of a new reservoir, are not considered feasible; these alternatives, eliminated from further consideration, are reviewed below (p. 516).

As part of its recent investigation of the Alameda Creek watershed, the SFWD examined surface water storage options.[1] That report concluded that the gravel quarries in the Sunol Valley could be developed for storage for surface flows. The study estimated that immediate completion of the presently permitted mining could provide up to 26,880 AF additional surface water storage. Additional water storage potential (totaling up to 79,450 AF) could result from the continuation and expansion of gravel quarries within this valley. The gravel quarries could be converted for surface storage with relatively minimal facilities. The report noted that early completion of the existing quarrying operations through deepening of the pits would result in a near-term enhancement of the City's water supply, whereas allowing the expansion of existing quarries would defer use of the pits for water storage and thus would represent a future potential for enhancement of water supply.

The SFWD is preparing to develop an Integrated Resources Management Plan to provide comprehensive, long-range guidance for water resources management. This effort will include more detailed analysis of potential conjunctive surface water and groundwater uses, including further investigation of surface flow storage at the Sunol Valley quarries.

Groundwater Storage

Storage in groundwater basins outside the City and County of San Francisco has been investigated and is not considered to be feasible at this time as discussed below under New Surface Water Storage Facilities (see p. 516). As proposed in the GWMP and also initiated by the Lake Merced Policy Resolution passed by the PUC in May 1995, the SFWD is to investigate possible groundwater storage/conjunctive use in the Westside Basin which extends along the

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[1] San Francisco Water Department, *Alameda Creek Water Resources Study*, January 1995. Prepared by Bookman-Edmonston.

western portion of the City south into San Mateo County. Conjunctive use of the City's groundwater basin for surface water storage, therefore, is a component of the GWMP and not really a separate alternative. The feasibility of using this groundwater basin for storage under an active recharge program has yet to be determined, and additional study is needed to characterize subsurface flow and storage conditions. It is possible that the Westside Basin could offer storage capacity that would allow the SFWD to increase imported water supply over current levels.

Summary

Overall, as an alternative to either the RWMP and/or GWMP, increasing existing water supply by increasing storage capacity would meet SFWD's objective to improve water supply reliability. It is possible that additional storage could yield as much or more additional potable water supply for the City as would result from the potable water savings achieved by the RWMP and GWMP. Developing the Sunol Valley quarries for surface storage could provide two to seven times the amount of potable water that would be saved by the RWMP and GWMP. The storage capacity of the Westside Basin is not fully understood. It may also be able to store more potable water for SFWD use.

However, the additional storage alternative would not achieve the other shared RWMP/GWMP objectives outlined above (p. 502). Increasing imported water supply would not: coordinate management and conservation of the City's water supply; improve and expand the City's fire protection system; preserve high quality Hetch Hetchy water for potable uses; or maximize recycled water use. Increasing imported potable water supply without implementing the RWMP and GWMP would maintain or increase the amount of potable water used for non-potable uses.

The impacts of developing new surface storage at the Sunol area quarries or within the City's groundwater basin have not been analyzed in detail. At this time, the impacts of these alternatives cannot be fully compared with the impacts of the RWMP and GWMP. However, a general summary of potential impacts for these alternatives can be outlined.

With respect to the quarries, much of the environmental impact to the local area has already resulted from the quarrying operation and conversion to storage facilities would not be expected to require substantial additional land alteration. Some additional facilities construction would be required (e.g., pump stations, conduits and pipelines). In the long-term, use of these quarries for surface water storage might create opportunities for environmental and land use enhancement and benefit. These water storage areas could be a water supply for plants and animals, open

water habitat for aquatic life and water fowl use, and might offer recreational opportunities as well. (These storage facilities within former gravel pits would be similar to those currently managed by the Alameda County Water District in Fremont.) Operation of the storage facilities would have limited operational impacts, but if multiple use activities such as wildlife and recreation were proposed, these could have impacts on the remaining environment and local communities.

San Francisco continues to investigate the Westside Basin. In particular, the City has been investigating the Lake Merced area to determine the effect of current groundwater use on the lake (which is an expression of the groundwater table) and to assess possible options for restoring lake water levels. As discussed in Section 5.B.2, Groundwater Impacts for the GWMP, the proposed in-lieu recharge project, which would increase water storage in the groundwater basin, could have a beneficial impact of restoring lake water levels. However, a change in lake water levels over current levels could alter the perimeter wetland habitat that has established as the levels have declined. Using the groundwater basin for storage would also require the construction of additional facilities, such as injection/extraction wells, pump stations, and pipelines, similar to the facilities proposed as part of the GWMP.

OTHER PROGRAM ALTERNATIVES DETERMINED TO BE INFEASIBLE

Water Conservation

Water conservation was considered as a program alternative to the RWMP and GWMP in that, similar to the RWMP and GWMP, it could further reduce potable water demand, and in this way meet the City's objectives of increasing water use efficiency. Water conservation involves many types of demand management actions, including physical activities such as plumbing retrofits and landscape modifications; however, it does not involve the type and magnitude of facilities construction proposed under the RWMP and GWMP. Water conservation measures can reduce potable water demand considerably. However, as discussed below, the City has already implemented many water conservation measures and has instituted permanent conservation programs (see Table 1, p. 10, for a list of resolutions and ordinances adopted by the Board of Supervisors regarding water conservation). As a result, the City has already achieved (or is in the process of achieving) much of the potable water savings possible through conservation. While there remains some potential for additional water conservation efforts to achieve further permanent reductions in the City's potable water demand, this potential is very limited. The City's current water conservation efforts and remaining conservation potential are summarized

below and are not presented as a potential program alternative but rather as an explanation of why water conservation is considered to be part of the existing water use setting.

Water conservation began as an explicit part of water supply management following the drought in 1976-77. Official actions were implemented to achieve water conservation and the general consumer developed a conservation ethic. Within the City's water service area, continued use of water conservation measures resulted in maintaining water consumption below the levels prior to the 1976-77 drought until 1986, despite growth.[2]

The City's water conservation program is presented in its Urban Water Management Plan.[3] The Urban Water Management Planning Act of 1983 required every water supply agency of a given size to prepare an Urban Water Management Plan by 1985 outlining its water conservation plan for the next five years. The plan must identify specific measures and an implementation schedule. The Act was subsequently amended to require the update of these plans every five years. These plans must be submitted to the Department of Water Resources.

The City's initial plan (1985-1990) addressed 17 separate areas of water conservation. The 1990 Plan update focuses on implementation of the Best Management Practices (BMPs) for water conservation developed in a statewide effort. These BMPs are reviewed below. The 1990 Plan also acknowledges the City's intent to investigate development potential for recycled water and groundwater to augment the City's supply.

In January 1992, San Francisco adopted a Water Shortage Contingency Plan as an amendment to its 1990 Urban Water Management Plan, in accordance with state law.[4] The Contingency Plan outlined the City's latest program for mandatory rationing. During the 1986-92 drought, the City imposed a 25 percent mandatory rationing program in five of the six years.

The City and its wholesale customers have instituted a number of water conservation measures which are summarized here. Distribution system losses are minimized through routine maintenance and upgrades to eliminate leaks and repair meters. Virtually 100 percent of the City's customers have meters which register and measure the rate of water consumption. This allows the City to closely monitor use and to increase fee charges as consumption increases.

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2 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-141.

3 City and County of San Francisco, Public Utilities Commission, *Urban Water Management Plan, AB 797 Update*, December 1990.

4 City and County of San Francisco, Public Utilities Commission, *Water Shortage Contingency Plan*, January 1992.

Metering allows water pricing that encourages and enforces conservation. With respect to water pricing, the City's average rates are relatively high compared to the statewide average and Central Valley communities.[5] Thus, the City has a rate structure which discourages excessive use of water.

The City also manages an ongoing public information program to educate the public on ways to reduce water consumption. The City helped develop and implement the Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California. This agreement was negotiated as part of the hearings held by the State Water Resources Control Board regarding the Delta Estuary. It establishes efficient urban water use by outlining a set of Best Management Practices (BMPs) that all signatories agreed to implement. The BMPs describe conservation actions and programs to be implemented in urban areas (e.g., use of low-flow plumbing fixtures, landscape restrictions, conservation-oriented water pricing, water audits). The City and its wholesale customers (represented by the Bay Area Water Users Association) are members of the Steering Committee for the California Urban Water Conservation Council, created by the MOU.

Implementation of the BMPs and other programs are overseen by the Water Department's Conservation Unit. The City's active conservation efforts include: commercial water audits; issuance of conservation affidavits for multi- and single-family accounts to ensure compliance with City Ordinances 185-91 and 346-91 requiring low-flow plumbing fixtures; new customer information packets describing conservation requirements and ideas; and public education activities such as demonstration drought-tolerant gardens and various school and public outreach programs.[6]

The City does not expect that additional conservation can offset increasing water demands due to growth or eliminate the potential for water shortages during drought periods.[7] Water consumption has already been reduced through conservation. Conservation efforts to date have, in effect, "hardened" the remaining water demand. After five mandatory water rationing episodes in San Francisco since 1977, many conservation measures, such as installation of low-flow plumbing fixtures and drought-tolerant landscapes, have already been implemented.

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5 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-143.

6 The Commission on San Francisco Environment, *The Environmental State of the City Report*, July 1994.

7 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-143. p. V-82.

If water shortages occur in the future, water rationing would yield diminished savings, since there would only be limited opportunity for additional conservation. City water consumption rates are already relatively low. Prior to the 1976-77 drought, water use for City retail customers was about 160 gallons per capita per day (gpcpd).[8] Following the drought, the rate of water use dropped and remained at 130 gpcpd. By the end of the recent 1986-92 drought, retail customer water use was about 96 gpcpd, of which residential use was 53 gpcpd. These gross consumption values for San Francisco are lower than most urban areas in the state.[9,10]

Other Sources of Water Supply

To improve the long-term reliability of the water supply system, the City has examined its various alternative supply options as well as those of its 30 wholesale customers. The City has identified a water supply deficit for both its system as well as for the other sources of supply used by its customers (see discussion in Chapter VI, p. 435 to 452; Table 49, p. 448 and Table 50, p. 450). Other sources of supply currently in use by City water customers include:

- imported water from the State Water Project and/or federal Central Valley Project;
- local reservoirs for surface runoff;
- groundwater; and
- recycled water.

The City has determined that the potential to expand supply from these sources is limited by both technical, environmental and political constraints and, in some instances, current supplies may be reduced rather than expanded (such as reduction in Delta water exports).[11]

Within the City's wholesale customer service area, groundwater is already used by several communities in addition to imported surface water (see Chapter VI, Section C, Water Supply, Other Supply Sources, pp. 441 to 442). Expansion of groundwater use is dependent in large part on the availability of additional imported surface water to support conjunctive use. Existing surface water import supplies from the State Water Project and Central Valley Project, and possibly from Hetch Hetchy, are all currently subject to potential reduction due to various regulatory proceedings.[12] Reductions in current imports of water would encourage regional

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8 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-143. pp. 81-82.

9 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-143. p. 82.

10 City and County of San Francisco, Public Utilities Commission, *Urban Water Management Plan, AB 797 Update*, December 1990.

11 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-143. p. 123.

12 City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-124.

increases in groundwater extraction, and would diminish the amount of stored groundwater available to the wholesale customers. Because the extent of groundwater extraction depends on the availability of imported surface water, the amount of stored groundwater may be reduced if imported surface water supplies are reduced.

The ability of the City and its wholesale customers to offset water supply shortages with additional imports of water from the Delta is severely constrained. The City has no facilities of its own to provide pumping and conveyance out of the Delta, and would rely on the availability of facilities of the State Water Project and Central Valley Project which are already constrained by regulatory conditions. During periods of drought, those agencies that do have access to the facilities (including several of the wholesale customers, with either direct or indirect access) also pursue water transfers and purchases to offset reductions of supplies from the State Water Project and Central Valley Project. However, due to constraints within the pumping and conveyance facilities (both physical and regulatory), and the seasons when water is available in the Delta (vs. when the water is needed by the City and its wholesale customers), the opportunity to increase supplies through transfer and purchases is limited.

The U.S. Fish and Wildlife Service has expressed concern over the potential environmental impacts associated with water supply proposals that would further alter the flow regime of the Delta estuary system.[13] Increasing surface water diversion and storage could affect the Delta. The Delta ecosystem is already a stressed water system, with several of its species now endangered.

Development of other sources of water supply described above does not appear to be a feasible alternative to implementation of the RWMP and GWMP plan. In summary, future water shortages to the City's retail and wholesale customers would not be offset by supplemental imported sources of water supply currently available.[14]

New Surface Water Storage Facilities

As part of a regional water supply investigation, the U.S. Army Corps of Engineers (Corps) reviewed options for increasing reservoir capacity by either increasing the capacity of existing

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[13] U.S. Army Corps of Engineers, San Francisco District, *San Francisco Regional Water Supply General Investigation*, March 1993.

[14] City and County of San Francisco, Public Utilities Commission and Hetch Hetchy Water and Power Department, *Response to Data Request Concerning FERC Opinion 4210*, June 8, 1993. p. V-125.

reservoirs (i.e., Hetch Hetchy, San Antonio, or Crystal Springs) or developing new reservoirs.[15] However, this study acknowledged several constraints limiting the feasibility of the surface storage projects.

C. PROJECT ALTERNATIVES

This section addresses possible alternatives to the RWMP on a project level that could achieve some or all of the RWMP specific objectives. The feasible project-level alternatives for the RWMP are alternative reservoir site locations and alternative RWTP site locations, as discussed below. The DPW also examined numerous variations to the overall RWMP system configuration, but were all determined to be infeasible, as discussed below. The project-level alternatives that were determined to be infeasible include the following: non-AWSS distribution system alternative; increased recycled water demand alternative; centralized storage system alternative; and separate reservoir located in the Richmond zone.

The GWMP has no specific project-level alternatives, since it is more of a conceptual plan than the RWMP with fewer project-level components. The possible types of project alternatives are described along with procedures for future environmental review.

RWMP PROJECT ALTERNATIVES

Recycled Water Storage Reservoirs - Alternative Sites

During the preliminary phase of RWMP development, the Department of Public Works (the RWMP is currently under the PUC) conducted a detailed process of identification and evaluation of potential recycled water reservoir sites at various remote locations throughout the City.[16] About 50 initial sites were selected based on existing uses, ownership, (preferably City and property), and minimum size criteria. These potential reservoir sites were then evaluated based altitude, size, geotechnical conditions, existing uses and restoration requirements, compatibility with the recycled water service areas, proximity to the existing AWSS, pipeline access, and other environmental concerns. Appendix D describes the reservoir sites considered, summary of the site evaluation, and preliminary ratings.

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[15] U.S. Army Corps of Engineers, San Francisco District, *San Francisco Regional Water Supply General Investigation*, March 1993.

[16] San Francisco Department of Public Works, Reclaimed Water Reservoir Location Evaluation, July 28, 1994.

Most of the potential reservoir sites are within public parks and school grounds. Many of these sites would feasibly meet the objectives of the RWMP, although Lincoln School and McLaren Park were selected as the apparent best alternative for the Southwest and Southeast service zones, respectively. Compared to the other sites that could serve the Southwest Zone, Lincoln High School/McCoppin Square best met the altitude and site location criteria, since its central location could service the Southwest Zone as well as provide access to reservoir sites in the Northwest (Richmond) Zone with a pump station; it received the highest preliminary rating of all potential reservoir locations in the Southwest Zone. In the Southeast Zone, although there were other sites which met the altitude criteria, McLaren Park was selected due to its favorable location for AWSS storage and because it would provide the least construction disturbance to existing and adjacent uses. In addition, reservoir sites were evaluated in the Northeast (Richmond) Zone, for which a separate reservoir had been planned in the RWMP but was later eliminated as discussed below (see Richmond Zone Reservoir Alternative under RWMP Project Alternatives Determined to be Infeasible, p. 523).

Some of the alternative sites cannot accommodate reservoirs as large as the proposed sites. Reducing the size of the reservoirs could require construction of more than one reservoir per zone in order to meet fully the recycled water projected demand. In this case, recycled water users might have to install booster pumps onsite. If there were more than one reservoir per zone, there would be additional construction disturbance at the additional site, and there would be potential cumulative construction impacts associated with reservoir construction at more than one site within a service zone.

In comparison to the sites proposed under the RWMP, construction of a buried reservoir at any of the alternative reservoir sites would result in similar environmental and land use impacts to the proposed project. Park and school uses would be disrupted during construction and would be fully restored following construction. Adjacent neighborhoods would be disrupted by construction activities' temporary effects, including truck traffic, noise, vibration, and dust. These alternative sites would not substantially avoid or minimize the impacts associated with construction of project reservoirs at the proposed sites. Therefore, Lincoln High School and McLaren Park were the only sites selected for more detailed evaluation and preliminary design considerations.

Recycled Water Treatment Plant Alternative Sites

An alternative sites assessment and screening study was conducted to examine potential sites for the westside recycled water treatment plant (RWTP) and to provide environmental screening to assist in site selection for the apparent best alternative. Five alternative sites for the treatment plant were identified as follows: (1) National Guard Armory near the San Francisco Zoo, (2) Balboa Reservoir near the City College of San Francisco, (3) Fleishhacker Pool, west of the San Francisco Zoo, (4) Richmond-Sunset WPCP in Golden Gate Park, and (5) San Francisco State University (SFSU) soccer field. The locations of these sites are shown in Figure 66. The environmental screening was based on five key environmental issues: land use, visual quality, biological resources, hazardous materials, and cultural resources; the screening results are summarized below.

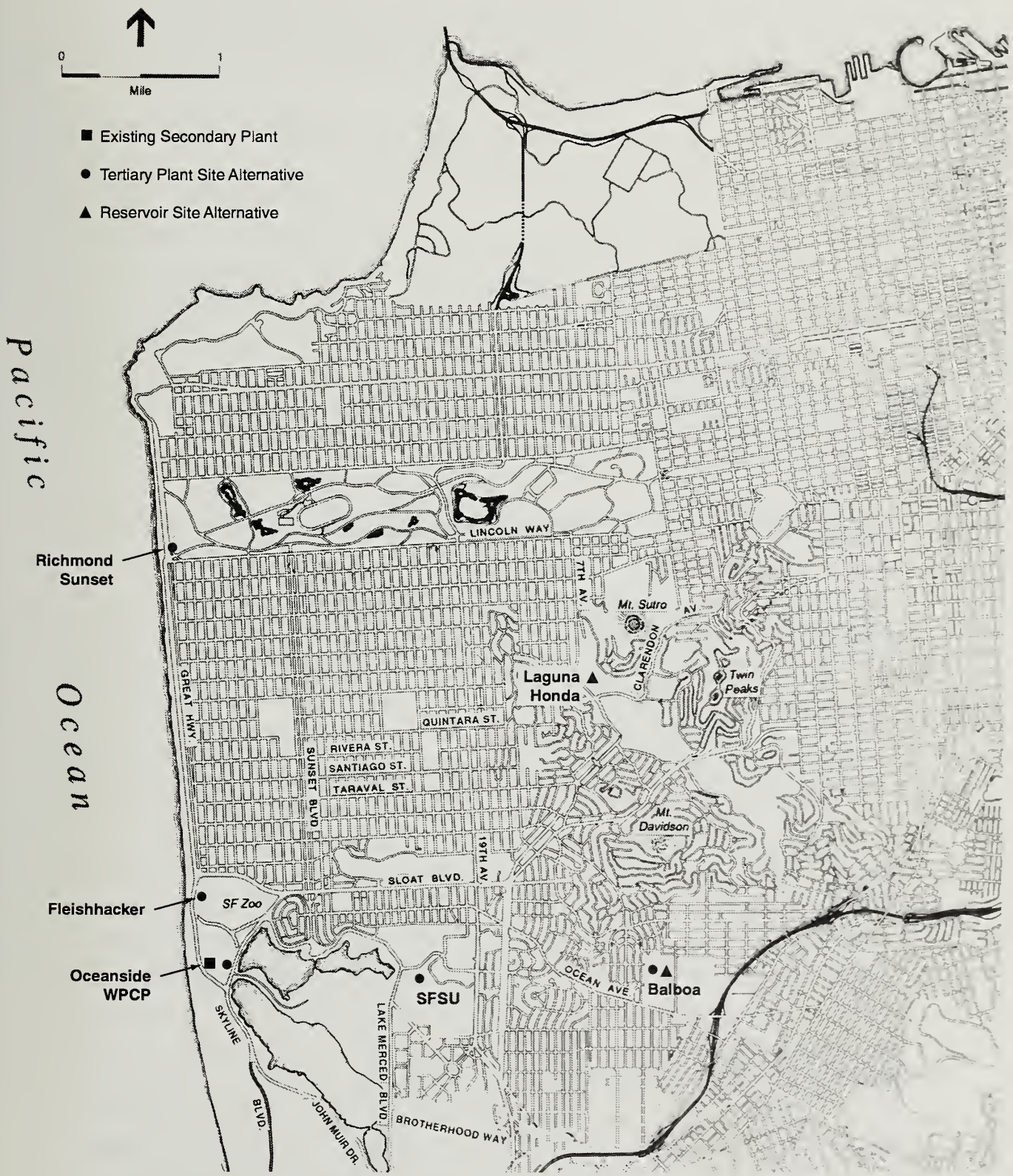
Project Objectives and Comparison with Proposed Project

Any of the four alternative treatment plant sites to the selected Fleishhacker site would meet the objectives for the RWMP. Overall, the site screening analysis indicated that the Fleishhacker Pool site had the least environmental constraints, followed by the Richmond-Sunset WPCP, Balboa Reservoir, SFSU soccer field, and the Armory. For further details, refer to San Francisco Draft Water Recycling Master Plan, Alternative Sites Assessment and Screening Study, 1993.

Alternative Site Descriptions

The National Guard Armory is a seven-acre site located adjacent to the Oceanside WPCP and the Zoo. The site is under the jurisdiction of the San Francisco Recreation and Park Department, occupied by the California Army National Guard under a 99-year lease to the State of California. Use of this site would require relocation of the National Guard, which could result in land use impacts. The site is generally not visible in short-range views, and there are undeveloped areas of the site which support some habitat for native plants and common wildlife species. It was determined to have low potential for hazardous waste or cultural resources to be on the site.

The Balboa Reservoir, located in the Ingleside area of San Francisco, adjacent to City College of San Francisco, is a concrete-lined water reservoir that has never been used for that purpose, but is used now for a parking lot for City College. The site is located adjacent to two schools which are considered sensitive land uses, and the site would be visible from surrounding land uses.



SOURCE: Environmental Science Associates

SF RWMP / GWMP Program EIR ■

Figure 66
Alternative Tertiary Treatment Plant and Storage Reservoir Locations – Westside

There are no biological resources, or any known hazardous waste contamination or cultural resources. This site could also result in potential land use impacts.

Fleishhacker Pool site is discussed under the proposed project, and construction of the RWTP at this site was determined to have the least environmental effects.

The Richmond-Sunset WPCP, located on 4.9 acres at the southwestern corner of Golden Gate Park, formerly provided sewage treatment for the westside of the City. Use of the site is designated for recreational uses, but existing vegetation provides visual isolation from the rest of Golden Gate Park. There are no sensitive biological resources at the site. However, there could be hazardous waste contamination potential due to the previous use as a treatment plant, and it is located adjacent to the Caretakers House, a potential historic resource. Thus, this site could result in potential land use and public health impacts.

The San Francisco State University (SFSU) soccer field is located in the Lakeshore district of southwestern San Francisco at the northwestern edge of the campus. The site is designated for maintenance facilities, and the adjacent school population are considered sensitive receptors. The biological resources are urbanized, and there were no cultural resources identified. There were possible indications of hazardous waste on-site. The site could also result in potential land use compatibility and public health impacts.

RWMP PROJECT ALTERNATIVES DETERMINED TO BE INFEASIBLE

Non-AWSS Distribution System Alternative

During the initial development of the RWMP, there was uncertainty as to the acceptability of using the AWSS system for the dual purpose of fire fighting and recycled water distribution. The City therefore developed a systemwide RWMP alternative that would require construction of an entirely new distribution system for the recycled water, plus the associated recycled water treatment plants (see discussion below regarding need for more than one treatment plant) and storage reservoirs. This alternative would require approximately 143,000 feet (27 miles) of new pipelines, compared to 57,000 feet (11 miles) of new pipelines for an equivalent alternative developed at that time which used the AWSS. There would be noticeably more construction disruption throughout the City streets under this alternative. This alternative was eliminated from further consideration after the San Francisco Fire Department (SFFD) determined that use of the AWSS for recycled water distribution would be acceptable in all areas of the City except

the downtown area. At that time, the objective of the RWMP was revised to include the expansion and improved reliability of the fire protection water supply and distribution system.

Increased Recycled Water Demand Alternative

During the initial development of the RWMP, the estimated demand for recycled water throughout the City was about 20.5 mgd (compared to 10.8 mgd for the proposed project). This level of demand required that two recycled water treatment plants be constructed in order to meet the Citywide demand. One plant would be on the westside of the City, treating effluent from the Oceanside Water Pollution Control Plant (WPCP), and serving recycled water users on that side of the City; the location of this plant would be the same as the proposed project. A second recycled water treatment plant would be constructed on the eastside of the City, treating effluent from the Southeast WPCP, and serving recycled water users on the eastside of the City; the location of the eastside recycled water treatment plant would be within the confines of the Southeast WPCP (generally bounded by Jerrold and Evans avenues, and Phelps and Rankin streets).

The reason for the previously estimated increased demand was due to the previous requirement to use recycled water for process water use at the City's water pollution control plant; the Department of Health Services has since determined that tertiary treatment is not required for process water at these plants. Therefore, due to the reduced demand for recycled water, the City determined that only one recycled water treatment plant would be required. The westside treatment plant was selected over the eastside treatment plant because the quality of the effluent from the Oceanside WPCP is better (lower salts and less industrial sources) and because the greater concentration of identified recycled water users is on the westside. Thus, this alternative was eliminated from further consideration.

Centralized Storage Reservoirs Alternative

Under this alternative, one single large reservoir would be constructed to serve the recycled water distribution system rather than the two, decentralized storage reservoirs proposed in the RWMP. Two alternative sites were considered: (1) Laguna Honda reservoir and (2) Balboa Reservoir (see Figure 66). The City conducted an alternatives assessment and screening analysis for these sites which evaluated five key environmental issues: land use, visual quality, biological resources, hazardous materials, and cultural resources; the screening results are summarized below. With respect to the plan objectives, construction of a centralized reservoir could address

the demands of the recycled water users but it would not provide the additional fire protection capability that the proposed decentralized reservoirs could provide.

The Laguna Honda Reservoir, located near Twin Peaks at the base of Mount Sutro, is a concrete-lined reservoir, formerly used as storage for potable water. The site is in the Open Space Height and Bulk District, and is visible in long-range views from residences at higher elevations. The site supports a number of biological resources and represents important plant and animal habitat, including both open water and wetland habitats. There were no indications of hazardous waste contamination or cultural resources at the site. This site could result in potential biological resources impacts.

The Balboa Reservoir site is the same as previously described under Alternative Treatment Plant sites (p. 519).

The Laguna Honda and Balboa reservoir sites were eliminated from further consideration due to the revised systemwide approach to provide de-centralized storage in different pressure zones. This revised approach was developed in subsequent planning phases of the RWMP in order to achieve the objectives of providing the dual purpose for fire protection water and recycled water supply for identified users. Due to the elevation requirements of the revised RWMP and of the fire fighting needs, the Laguna Honda and Balboa Reservoir sites were no longer suitable due to engineering and hydraulic requirements (i.e., these sites are not at a sufficiently high elevation).

Richmond Zone Reservoir Alternative

One of the RWMP system alternatives examined by the DPW include an additional, separate reservoir to serve recycled water users in the Richmond Zone. The purpose of a reservoir at this location, in addition to serving recycled water users, would be to provide additional emergency fire fighting protection in this area. The SFFD indicated minimum elevation requirements in order to provide gravity flow for fire fighting in the event of power outage, and two feasible sites were identified that meet this criteria: Golden Gate Heights Park and Buena Vista Park. (Herbert Hoover School was also considered as a site, but was eliminated from further consideration due to land use and size constraints.) The DPW then proceeded with preliminary reservoir designs at these two sites that would meet both the fire protection and other recycled water user needs. Potential environmental effects associated with construction of a reservoir at

these sites were analyzed in detail;[17] however, subsequent to this analysis, the SFFD indicated that the reservoir planned at these sites would not meet their system needs for fire protection. Even though the reservoir at these sites would provide adequate elevation, it would not provide adequate capacity, and the SFFD determined that the size criteria is more critical than the elevation criteria. Therefore, these two reservoir sites and this alternative were eliminated from further consideration.

GROUNDWATER MASTER PLAN

There are no systemwide project-level alternatives to the GWMP. Project-level alternatives to the near-term activities (5A1 and 5A2, to capture groundwater flow lost to the Bay or Ocean) are listed in the GWMP and include potentially installing wells at Ocean View Playground, Laguna Honda Home, St. Mary's Hospital, State of California -Font Boulevard, Stonestown Properties, San Francisco State University, Lake Merced Sports Center, near 44th Avenue, south of Golden Gate Park near 23rd Avenue, and Stern Grove. However, this list of projects would not be considered alternatives to the project, per se, but rather a list of future potential projects that may be implemented as the GWMP evolves and more detailed hydrogeologic information is collected. In order for any alternative site location to be considered a feasible alternative to any of the proposed production wells, more detailed hydrogeologic investigations would be required. Impacts associated with production well construction and installation would be generally similar to those aspects of the proposed project, with site-specific effects depending on the location and design of the well. Any such additional specific projects, if proposed as a subsequent part of the GWMP, would be subject to further environmental review on a case-by-case basis.

Similarly, project-level alternatives to the near-term activity 5B1 (to capture groundwater produced by dewatering operations) are also listed in the GWMP. This lists includes potentially installing wells at Alta Plaza Park, Civic Center Plaza, Hamilton Playground, Jefferson Square, Kimball Playground, Margaret Hayward Playground, Union Square, and Moscone Center. This list of projects, however, again would not be considered alternatives to the project, per se, but rather a list of future potential projects that may be implemented as the GWMP evolves and more detailed hydrogeologic information is collected. Any such additional specific projects, if proposed as a subsequent part of the GWMP, would be subject to further environmental review on a case-by-case basis.

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[17] Environmental Science Associates, *Technical Memorandum - Richmond Zone Reservoir Alternatives: Golden Gate Heights and Buena Vista Park Sites*, December 1995.

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APPENDICES

APPENDIX A

NOTICE OF EIR REQUIREMENTS

City and County of San Francisco
The Planning Department

1660 Mission Street
San Francisco, CA 94103-2414

December 9, 1994

RE: 92.371E - San Francisco Recycled Water and Groundwater Master Plans
Environmental Impact Report Requirement

To Interested Parties:

A Notice that an Environmental Impact Report (EIR) is Determined to be Required for the above-referenced project is being sent to you because you have expressed an interest in the proposed project or the project area, or because you have been identified by the Planning Department as potentially having an interest in the project. Notice of publication of this document was printed in a newspaper of general circulation on the day that this was mailed to you.

As stated in the Notice, the Planning Department has determined that an EIR must be prepared for the proposed project prior to any final decision regarding whether to approve the project. The purpose of the EIR is to provide information about potential significant physical environmental effects of the proposed project, to identify possible ways to minimize the significant effects, and to describe and analyze possible alternatives to the proposed project.

This Notice is being sent to you to inform you about the status of this project, and to solicit comments you may have regarding what information should be included in the EIR. The Notice includes a summary of the information that the Department already intends to include in the EIR. If you believe that additional information should be included, please send those comments in writing to **Paul Maltzer**, at the Planning Department, 1660 Mission Street, 5th Flr., San Francisco, CA 94103, or call him at (415) 558-6391, by **January 16, 1995**.

Additionally, any person may appeal the determination to require an EIR in a letter which specifies the reasons why they believe that the proposed project could not possibly have significant environmental impacts. Send the appeal letter to the Department of City Planning, Attention: Barbara W. Sahm, 1660 Mission Street, San Francisco CA, 94103. **The letter must be accompanied by a check in the amount of $206.00 payable to the Department of City Planning, and must be received by 5pm on or before December 29, 1994.** The appeal letter and check may also be presented in person at the Planning Information Counter on the first floor at 1660 Mission Street, San Francisco.

An appeal requires the Planning Commission to determine whether or not an EIR must be prepared, based upon whether or not the project could have a substantial adverse effect on the physical environment. If an appeal is filed, there will be a public hearing at which anyone may testify for or against the contention that an EIR is required. In the absence of an appeal, the Planning Department will proceed with its decision to prepare an EIR.

Please note that preparation of an EIR does not indicate a decision by the City to approve or to disapprove the proposed project. However, prior to making any such decision, the decision makers must review and consider the information contained in the EIR.

If you have any questions concerning the attached materials or this process, please contact Paul Maltzer at the address or telephone number shown above.

Sincerely,

Barbara W. Sahm

Barbara W. Sahm
Environmental Review Officer

City and County of San Francisco
The Planning Department

1660 Mission Street
San Francisco, CA 94103-2414

December 9, 1994

MEMORANDUM

To: Responsible and/or Trustee Agencies

From: Barbara W. Sahm, Environmental Review Officer

Re: Enclosed Notice of Preparation

The City and County of San Francisco Department of City Planning will prepare an Environmental Impact Report for the following project:

92.371E - San Francisco Recycled Water and Groundwater Master Plans

On March 12, 1993, our office published and distributed a Notice of Preparation for a San Francisco Recycled Water Master Plan. Subsequent to that time, the San Francisco Water Department has developed a Draft Groundwater Master Plan, and the San Francisco Department of Public Works has revised its proposed Recycled Water Master Plan. Our office, as the Lead Agency under the California Environmental Quality Act, has determined that, due to the interrelationship between these two water use plans, a single Environmental Impact Report should be prepared which analyzes the potential impacts from the combined project.

Enclosed for your information are the following materials:

- a copy of the Notice of Preparation;
- a copy of the Determination that an Environmental Impact Report is required;
- a list of the potential environmental effects of the project; and
- a general description of the project alternatives currently being considered.

In order that your views can be considered during the environmental review process, your comments on the alternatives currently being considered and on the potential environmental impacts of the proposed project should be submitted within 30 days of receipt of this Notice (no later than January 16, 1995). Comments may be submitted in writing to the address below.

Submit written comments to:

Paul Maltzer
Department of City Planning
1660 Mission Street, 5th Floor
San Francisco, CA 94103

If you have questions about the environmental review process, please contact Paul Maltzer at the Department of City Planning, (415) 558-6391. Questions about the proposed project, or alternatives being considered may be addressed to:

Karen Kubick
Dept. of Public Works
1660 Mission Street - 4th Flr
San Francisco, CA 94103
(415) 554-8206

or

Frank Filice
Dept. of Public Works
1660 Mission Street - 4th Flr
San Francisco, CA 94103
(415) 554-8226

or

Christine Morioka
S. F. Water Dept.
425 Mason Street
San Francisco, CA 94102
(415) 923-2467

City and County of San Francisco
The Planning Department

1660 Mission Street
San Francisco, CA 94103-2414

NOTICE OF PREPARATION

To: Responsible and/or Trustee Agencies

From: City and County of San Francisco
Department of City Planning
Office of Environmental Review
1660 Mission Street, 5th Flr.
San Francisco, CA 94103

Re: Notice of Preparation of a Draft Environmental Impact Report

The City and County of San Francisco Department of City Planning will prepare an environmental Impact Report for the following project:

92.371E - San Francisco Recycled Water and Groundwater Master Plans

The project consists of two separate water management plans, a Recycled Water Master Plan, and a Groundwater Master Plan. Each Plan includes some program, or policy level proposals regarding use of recycled water and groundwater, respectively, as well as some project specific construction proposals related to water treatment, storage, extraction, distribution and use. The construction proposals include a treatment plant, storage reservoirs, pump stations, wells, transmission lines and a distribution system. A general description of the two proposed plans, including alternative sites under consideration, is included in the attached materials. The project is proposed by the San Francisco Department of Public Works and the Water Department.

Pursuant to State CEQA Guidelines, Section 15063, we have determined that an EIR will clearly be required to analyze this project and have therefore decided not to prepare an Initial Study. A summary of the potential environmental effects which will be analyzed in the EIR is enclosed.

We need to know the views of your agency regarding the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

Due to the publication of this Notice during the holiday period, our office assumes that mail delivery may take up to one week from the date of this Notice. The State CEQA Guidelines prescribe that responses must be submitted within 30 days of receipt of this Notice. Your response must be sent at the earliest possible date, **but no later than January 16, 1995**. Please send your response to Paul Maltzer at the address shown above. Please include the name of a contact person in your agency. Telephone inquiries may also be addressed to Mr. Maltzer at (415) 558-6391.

Barbara W. Sahm
Environmental Review Officer

12/9/94
(Date)

City and County of San Francisco
The Planning Department

1660 Mission Street
San Francisco, CA 94103-2414

NOTICE THAT AN ENVIRONMENTAL IMPACT REPORT IS DETERMINED TO BE REQUIRED

Date of this Notice: December 9, 1994

Lead Agency: City and County of San Francisco, Department of City Planning
1660 Mission Street - 5th Floor, San Francisco, CA 94103

Agency Contact Person: Paul Maltzer **Telephone:** (415) 558-6391

Project Title: San Francisco Recycled Water and Groundwater Master Plans

Project Sponsor: San Francisco Department of Public Works and Water Department

Project Contact Person: Karen Kubick (Dept. of Public Works) and Christine Morioka (Water Dept.)

Project Address: Assessor's Block(s) and Lot(s): Various alternative sites under consideration (see enclosed project description)

City and County: San Francisco

Project Description: The project consists of two separate water use plans, a Recycled Water Master Plan, and a Groundwater Master Plan. Each Plan includes some program, or policy level proposals regarding use of recycled water and groundwater, respectively, as well as some project specific construction proposals related to water treatment, storage, extraction, distribution and use. The construction proposals include a treatment plant; storage reservoirs; pump stations; extraction, monitoring and injection wells; transmission lines; and a distribution system. A general description of the two proposed plans, including alternative sites under consideration, is included in the attached materials.

THIS PROJECT MAY HAVE A SIGNIFICANT EFFECT ON THE ENVIRONMENT AND AN ENVIRONMENTAL IMPACT REPORT IS REQUIRED. This determination is based upon the criteria of the Guidelines of the State Secretary for Resources, Section 15063 (Initial Study), 15064 (Determining Significant Effect), and 15065 (Mandatory Findings of Significance), and the following reasons, as documented in the Environmental Evaluation (Initial Study) for the project, which is attached.

Deadline for Filing of an Appeal of this Determination to the City Planning Commission: 12/29/94
An appeal requires: 1) a letter specifying the grounds for the appeal, and;
2) a $206.00 filing fee.

Barbara W. Sahm
Environmental Review Officer

ADMINISTRATION (415) 558-6414 | CITY PLANNING COMMISSION (415) 558-6414 | PLANS AND PROGRAMS (415) 558-6264 | IMPLEMENTATION/ZONING (415) 558-6377

FAX: 558-6409 FAX: 558-6426

92.371E - SAN FRANCISCO RECYCLED WATER AND GROUNDWATER MASTER PLANS

SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

The proposed project consists of two separate water use plans, a Recycled Water Master Plan, and a Groundwater Master Plan. Each Plan includes some program, or policy level proposals regarding use of recycled water and groundwater, respectively, as well as some project specific construction proposals related to water treatment, storage, extraction, distribution and use. A more detailed description of the proposed project is included in the attached materials. The EIR will analyze the potential environmental effects of the two proposed plans at both the policy level, and at the project-specific level for the construction projects that are proposed in each plan. Mitigation measures for potential impacts which are identified will be discussed, as appropriate.

Potential effects on the following environmental features and issues will be considered:

land use/zoning
water quality, including public health issues
hydrology
visual quality/aesthetics/urban design/shadow
transportation
noise and vibration
air quality, including odor and wind
biology
geology, including issues related to seismic activity, and subsidence
hazards, including ground and water contamination, and chemical usage
archaeological and historic resources
public services and utilities
energy
population and growth inducement

Construction related, or temporary effects, will be considered as well as operational, or permanent effects.

PROJECT DESCRIPTION

Background.

In October, 1991, the San Francisco Board of Supervisors passed Ordinances 390-91 and 391-91, which amended the Public Works Code by adding Article 22, otherwise known as the Reclaimed Water Use Ordinance. The ordinance mandated, in part, that recycled water and groundwater be developed for beneficial uses, wherever reasonable. The ordinance also directed the Department of Public Works and the Water Department to prepare a Groundwater and Reclaimed Water Use Master Plan. Pursuant to the Board of Supervisors' direction, the City and County of San Francisco Department of Public Works and Water Department have undertaken the preparation of a Recycled Water Master Plan (RWMP) and a Groundwater Master Plan (GMP). The basic objective of both plans is to maximize the efficient use of available water resources, to ensure future availability of water supplies of suitable water quality for appropriate uses. These Plans are described in more detail below.

Recycled Water Master Plan

The RWMP is intended to provide long term guidance for the development and use of recycled water for non-potable uses throughout the City. The basic goals of the RWMP are to:

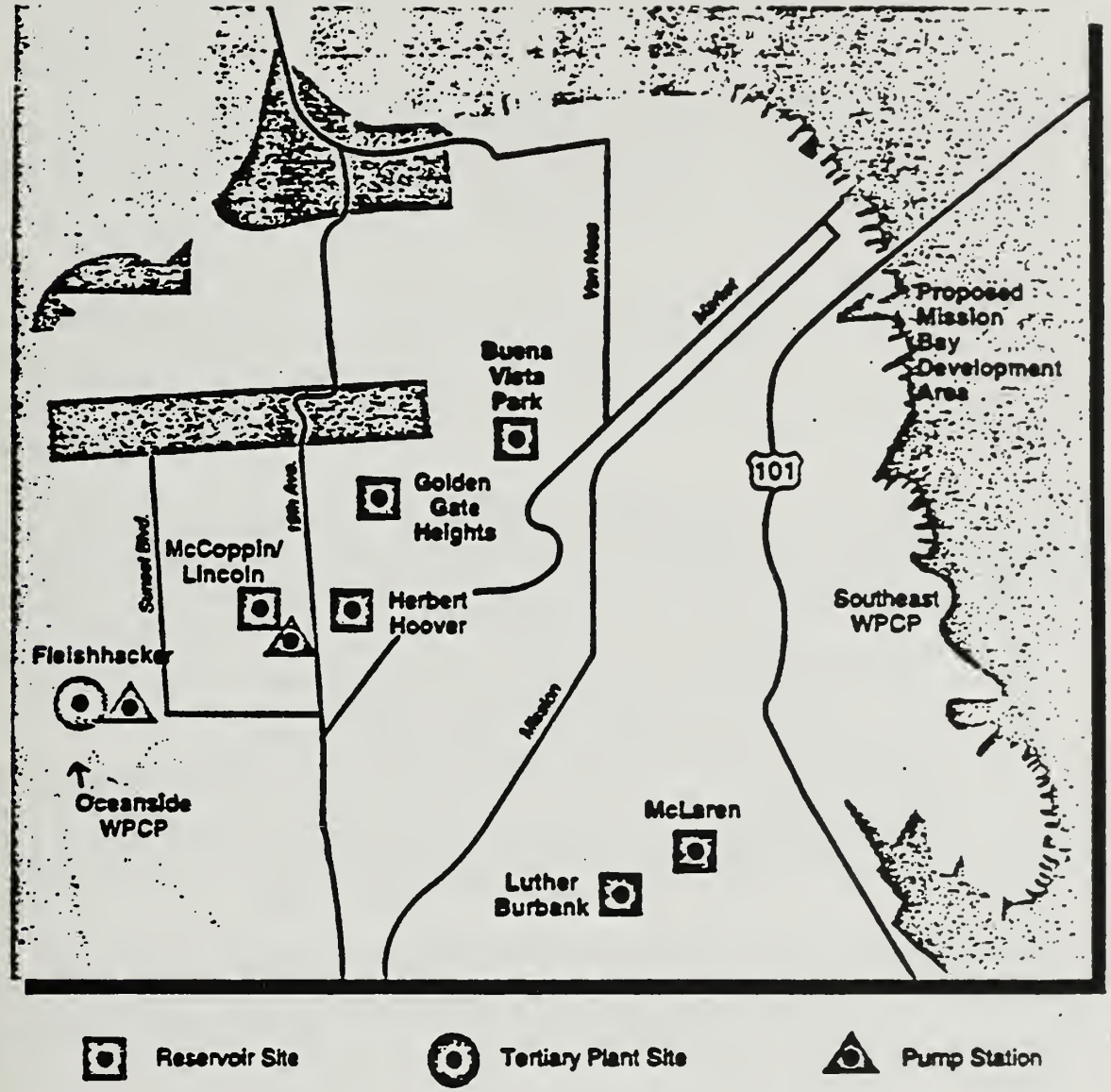
- Provide a firm and reliable additional water supply for the city, particularly during periods of drought;
- Make available high quality Hetch Hetchy water for potable water uses; and
- Provide an emergency water supply to augment the fire protection capacity of the City.

Recycled water, also known as reclaimed wastewater, or reused water, is wastewater effluent from the City's sewage treatment facilities which would undergo additional treatment in order to meet specific water quality and public health regulations. The primary uses identified for recycled water include landscape irrigation, fire fighting, industrial process water, toilet flushing and office cooling systems. The RWMP identifies potential users and the corresponding treatment, storage and distribution facilities required for implementation throughout the City.

Project Components. The recycled water program in San Francisco would consist of four major components: a recycled water treatment plant; pump stations, transmission and distribution pipelines; and storage basins. The enclosed Figure 1 shows the sites of the treatment plant, reservoirs and pump stations under consideration in the RWMP.

Recycled Water Treatment Plant. The RWMP proposes that one recycled water treatment plant be built on the west side of the City. The treatment plant would receive secondary treated sewage effluent from the Oceanside Water Pollution Control Plant, adjacent to the San Francisco Zoo. The plant would be designed for a peak capacity of 21 mgd and would provide recycled water for users on both the west side and east side of the City. The new plant would require about four acres of land. The proposed treatment plant site is located where the Fleishhacker Pool previously existed, along the Great Highway near Sloat Boulevard, just west of the Zoo.

The treatment plant would take secondary level effluent (treated wastewater that has undergone physical and biological processes) from the Oceanside plant and treat it further (primarily filtration and disinfection) in order to meet California water quality criteria for recycled water.



SAN FRANCISCO WATER RECYCLING

PREFERRED TERTIARY TREATMENT PLANT AND POTENTIAL RESERVOIR LOCATIONS

FIGURE 1

Transmission Lines, Pump Stations and Distribution System. Transmission lines would convey recycled water from the recycled water treatment plant to storage reservoirs. The transmission lines would be located underground, primarily within roadways. Pump stations would pump the recycled water through the transmission lines and would be located at the recycled water treatment plant site, and at the Southwest zone storage reservoir site.

The distribution system would convey the recycled water from the storage reservoirs to the users through a network of underground pipelines. The RWMP proposes to make use of portions of the existing Auxiliary Water Supply System (a high pressure water supply system currently used only for fire fighting) for distribution of recycled water. The RWMP proposes to upgrade and expand the Auxiliary Water Supply System to accommodate both fire fighting and recycled water distribution, with fire fighting as the top priority use.

Storage Reservoirs. Storage reservoirs would consist of covered basins, each of which would provide 5 - 20 million gallons of storage capacity for recycled water. Reservoir capacities would be designed to provide an adequate volume of recycled water for identified users on a daily basis, and to provide an emergency reserve for fire fighting. Alternative reservoir sites include:

i) McCoppin Square, at 24th Avenue and Santiago Street;
ii) Lincoln High School, adjacent to McCoppin Square;
iii) Herbert Hoover Middle School, at Santiago and 14th Avenue;
iv) Golden Gate Heights Park, between Funston Avenue and 12th Avenue, near Lawton Street;
v) Buena Vista Park, at Haight Street and Central Avenue;
vi) McLaren Park, near Mansell Street and John F. Shelley Drive; and
vii) Luther Burbank Middle School, adjacent to McLaren Park.

Three reservoirs would be needed to serve the following operating zones:

Northwest: Requires a reservoir elevation of 500 feet or higher to serve Richmond district and east side of Golden Gate Park.

Southwest: Requires a reservoir elevation of 350 feet or higher to serve Sunset district and western portion of Golden Gate Park.

Southeast: Requires a reservoir elevation of 300 feet or higher on the east side of the City.

The presently preferred sites for storage reservoirs are Lincoln High School for the Northwest zone, Golden Gate Heights Park for the Southwest zone and McLaren Park for the Southeast Zone. The other sites identified above will be considered as possible alternative locations.

Groundwater Master Plan

The GMP identifies a variety of goals, strategies and activities in order to maximize the contribution of groundwater to the City's water supply, and guide groundwater development activities. The five principal goals identified in the GMP are:

- Protect and Enhance Groundwater Quality;
- Coordinate Groundwater Use;
- Protect and Conserve Related Water Resources;
- Use Groundwater as an Emergency Reserve; and
- Increase Groundwater Use.

The primary goals, long-term strategies and short-term activities are shown in the attached Table 1.

The GMP identifies the seven groundwater basins underlying San Francisco and adjacent jurisdictions, discusses the capacity, water quality and manageability of the various basins, and identifies potential users of groundwater. Groundwater could be used for both potable and non-potable purposes. Major non-potable groundwater uses include park landscaping, golf courses, toilet flushing and cooling systems. Potable use could range from a single extraction well feeding directly to a single user, to a local distribution network of users being served by an extraction well, to blending of groundwater into a main distribution system. Distribution of groundwater to users could take advantage of the existing water distribution system and/or the AWSS.

The variety of construction projects contemplated in the GMP could entail some combination of extraction wells, monitoring wells, injection wells, pump stations and transmission lines. The locations of the short-term projects presently under consideration are identified in Table 1. No new storage facilities for groundwater would be constructed, but water could be injected into existing groundwater basins for storage and basin management.

Regarding management of the various basins, the GMP discusses a wellhead protection program designed to maximize basin yield and minimize potential groundwater contamination. A key component of this program would be revision of the City's well permitting system. The GMP also discusses the need to coordinate with other governmental agencies and other jurisdictions regarding use and management of shared groundwater basins.

Additionally, the GMP discusses strategies for improving the City's ability to deliver water during emergencies, and also proposes strategies for monitoring existing lakes and streams in order to evaluate the effects of groundwater use over time.

Coordination of Plans

It is the intention of the Department of Public Works and the Water Department to ultimately integrate the two plans into a single comprehensive response to the mandate expressed in the Reclaimed Water Use Ordinance. The combined program, according to the ordinance, should include proposed policies and facilities for the beneficial use of groundwater and reclaimed water, consistent with legal requirements, economic considerations, the public health safety and welfare, and the preservation of the environment. The combined program would require review and approval by the Chief Administrative Officer and the Public Utilities Commission.

Table 1
Summary of the Water Department's Goals, Long-Term Strategies, and Short-Term Activities for Groundwater Management

Goal	Long-Term Strategy (next 20 years)	Short-Term Activity (next 5 years)
1. * Protect and Enhance Groundwater Quality	1A Prevent saltwater intrusion	1A1 Evaluate potential for saltwater intrusion
		1A2 Install "warning system" wells
	1B Monitor existing and reduce the risk of future industrial pollution	1B1 Develop and implement a Wellhead Protection Program
	1C Monitor groundwater levels, uses, and quality	1C1 Develop and implement groundwater monitoring program
	1D Identify and reduce the risk from other sources of groundwater pollution	1D1 Identify and reduce the risk from other sources of groundwater pollution
2. * Coordinate Groundwater Use	2A Establish Water Department as lead in City groundwater management	2A1 Establish a Groundwater Management Unit within the Water Department
	2B Improve coordination with other government agencies regulating/affecting groundwater use within the City	2B1 Form a City groundwater management committee
	2C Improve coordination with adjacent entities whose groundwater use affects shared groundwater basins	2C1 Form an AB 3030 management committee
	2D Enhance communication with Water Department customers	2D1 Develop and implement a Public Involvement Program
3. * Protect and Conserve Related Water Resources	3A Manage lake water levels	3A1 Evaluate effects of groundwater pumping on Lake Merced water levels
		3A2 Evaluate relationship of other City lakes with groundwater
	3B Manage stream water levels	3B1 Assess effects of groundwater development on Lobos Creek
		3B2 Evaluate relationship of other City streams and seeps with groundwater

* Note: Numbering system for Goals is not intended to imply priority or preference. All goals are considered by sponsor to be of equal importance.

Nov v 4, 1994

Table 1
Summary of the Water Department's Goals, Long-Term Strategies, and Short-Term Activities for Groundwater Development and Use

Goal	Long-Term Strategy (next 20 years)	Short-Term Activity (next 5 years)
4.* Use Groundwater as an Emergency Reserve	4A Improve ability to deliver water during emergencies	4A1 Study the feasibility of installing large-capacity stand-by wells (potable)
		4A2 Update the Water Department's Emergency Operations Plan
5.* Increase Groundwater Use	5A Capture groundwater outflow to the San Francisco Bay or Pacific Ocean - *Westside (North)*	5A1 Extract groundwater from Elk Glen well(s), add to local distribution system (potable)
		5A2 Extract groundwater from the Sunset District, add to main distribution system (potable)
		5A3 Extract groundwater from Stern Grove well, add to main distribution system (potable)
	5B Capture groundwater produced by dewatering operations - *Downtown*	5B1 Add groundwater from dewatering at the Powell Street BART to the AWSS system (not potable)
	5C Conjunctively operate groundwater basins - *Westside (South) and Lobos*	5C1 Conduct in-lieu recharge of the Westside Basin (South) (potable)
		5C2 Conduct conjunctive use in the Lobos Basin (potable)
	5D Investigate other groundwater basins - *Lobos, Marina, Islais Valley, South, Visitacion Valley*	5D1 Develop and implement a study of the Lobos Basin (potable)
		5D2 Develop and implement studies of other City basins
	5E Evaluate other potential activities for increasing groundwater use	5E1 Evaluate potential groundwater use in the City's fountains and decorative pools
		5E2 Evaluate the potential for groundwater to help control corrosion in the City's water distribution system

Note: When the long-term strategies apply to specific basins, the applicable basins are identified in italics.

DRAFT

* Note: Numbering system for Goals is not intended to imply priority or preference. All goals are considered by sponsor to be of equal importance.

RESPONSIBLE AND/OR TRUSTEE, AND OTHER INTERESTED AGENCIES

Responsible and/or Trustee Agencies

State Water Resources Control Board
Regional Water Quality Control Board
Department of Water Resources
Department of Health Services
Department of Fish and Game
Coastal Commission
Bay Area Air Quality Management District

Other Interested Agencies

Local

San Francisco

Department of Public Works
Water Department
Fire Department
Health Department
Recreation and Park Department
School District
Mayor's Office of Emergency Services

Hetch Hetchy Customers

State

Department of Conservation, Division of Mines and Geology
Department of Parks and Recreation

Federal

Department of Interior, National Park Service
GGNRA
Department of Interior, Geologic Survey
U.S. Army Corps of Engineers

APPENDIX B

REGULATORY BACKGROUND FOR RWMP / GWMP

APPENDIX B

REGULATORY BACKGROUND FOR RWMP / GWMP

WATER QUALITY

This Appendix discusses the regulations and authorities related to the RWMP and the GWMP, outlined in Table 2, Section II, Background, page 19, of this report. The management of recycled water and groundwater resources is regulated and guided by a variety of federal, state, and local regulations, standards and policies. This section begins with an overview of the two overarching laws governing water quality (excluding drinking water quality), the federal Clean Water Act and California Porter-Cologne Water Quality Control Act, followed by a discussion of regulation governing water recycling, groundwater, and drinking water. The unifying goal of these regulations is to ensure that water resources (surface, ground, and recycled water) are managed in such a way as to protect public health while maintaining their ecological and water supply values.

CLEAN WATER ACT

The objective of the federal Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" to make all surface waters "swimmable" and "fishable."[1] The Act required individual states to establish water quality standards to protect designated uses for all navigable waters of each state (Section 303). In addition, Section 303 of the Act required the states to characterize and rank all navigable waters within the state according to proposed use and degree of pollution.[2]

The Clean Water Act, Section 402, established the National Pollutant Discharge Elimination System (NPDES) permitting program, which regulates point source discharges to surface water and was later amended to regulate stormwater runoff as well.[3] As discussed below, permitting of recycled water use in California is now carried out under the NPDES program

1 *The Clean Water Act as amended by the Water Quality Act of 1987.* Public Law 100-4, March 1988.
2 Federal Clean Water Act §301-303, 1992
3 State Water Plan, Vol. 1, Chapter 2, pp. 30-31, Bulletin 160-93, 1994

PORTER-COLOGNE WATER QUALITY CONTROL ACT

The Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) provides the basis for California water quality regulation. This Act established the authority of the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards (RWQCB). The State Board administers water rights, water pollution control and water quality functions throughout the state, while the RWQCBs conduct planning, permitting and enforcement activities within their respective regions.

The Act directs the State Board to adopt statewide water quality control plans (WQCPs or Basin Plans) for surface waters and to establish quality standards as required by the Clean Water Act. The Act also requires the RWQCBs to adopt Basin Plans for waters in their respective regions. The Porter-Cologne Act designated the State Board responsible for formulating and adopting state policy for water reclamation, and the Department of Health Services (DOHS) for establishing uniform statewide reclamation criteria to ensure that the use of reclaimed water would not be detrimental to public health. Statewide reclamation policy and uniform statewide criteria are discussed in more detail below.

The Act also designated the RWQCBs as the responsible agency for implementing the NPDES program/permitting of wastewater discharges, including issuance of waste discharge requirements (WDRs), water reuse requirements, and master reclamation permits (the latter two are issued in consultation with the DOHS). The water reuse requirements and master reclamation permits are described at greater length below.

Finally, the Act designated the SWRCB and RWQCBs responsible for statewide groundwater planning and protection programs.

STATE AND FEDERAL ANTIDEGRADATION POLICIES

The federal Clean Water Act implementing regulations require that each state create an "anti-degradation policy" to maintain and protect the quality of its waters. In fulfillment of this requirement, the SWRCB adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California." This policy mandates that the existing quality of water be maintained, though some degradation may be allowed when deemed to be in the best interest of the state. In no case, however, is unreasonable adverse effect upon existing or probable beneficial uses of waters of the state to be allowed.

SWRCB Resolution No. 88-63, the "Sources of Drinking Water" policy states that, except under specifically defined circumstances, groundwaters of the state are either existing or potential sources of municipal and domestic drinking water supply. These two policies together designate the SWRCB and RWQCBs responsible for protecting both surface and groundwater resources of the state from degradation.

WATER RECYCLING

There are no federal standards governing wastewater reclamation and reuse in the United States, although the U. S. Environmental Protection Agency has sponsored the preparation of *Guidelines for Water Reuse*.[4] Many states, including California, have developed wastewater reclamation regulations. In all cases, the regulations have been established with the objective of protection public health and to allow for the safe use of reclaimed wastewater.

The Porter-Cologne Water Quality Act directs the DOHS and the State Water Resources Control Board (through the RWQCBs) to regulate water reclamation and reuse. The DOHS is charged with the responsibility of establishing and enforcing uniform statewide reclamation criteria to ensure that the use of the reclaimed water will not be detrimental to public health. The DOHS established water quality criteria, treatment process requirements, and treatment reliability criteria for reclamation operations in Title 22, Division 4, Chapter 3, of the *California Code of Regulations* (Title 22), which was promulgated in 1978.

The existing Title 22 regulations address treatment requirements for three types of reclaimed water uses: Landscape Irrigation, Recreational Impoundments, and Industrial Uses. The treatment requirements are based on the expected degree of human contact with reclaimed wastewater under each type of use. Treatment requirements are expressed as treatment process requirements (i.e., bio-oxidation, coagulation) as well as performance standards (i.e., disinfection and contaminant reduction). Permit applications for uses not explicitly addressed in the existing Title 22 regulations (such as fire fighting and toilet flushing) and treatment processes (such as direct filtration) are currently reviewed by the RWQCB and DOHS on a case-by-case basis. Table B-1 lists the existing Title 22 criteria for each allowed use.

The existing Title 22 standards are among the most stringent standards in the world for public health protection and are about 100 times more stringent than comparable standards established

[4] Camp Dresser & McKee Inc.; Crook, James; Ammerman, David; Okun, Daniel; and Matthews, Robert, 1992. *Guidelines for Water Reuse* Prepared for the U.S. Environmental Protection Agency and the U.S. Agency for International Development. Published by Camp Dresser & McKee, Inc., Cambridge, Massachusetts, October 1992.

by the World Health Organization. Since the adoption of Title 22 in 1978, the use of reclaimed water for non-potable purposes has expanded throughout the state and is projected to continue to grow over the next several decades. In addition, technical and health effects studies have been conducted and treatment technology has improved since 1978. Thus, the DOHS is currently in the process of revising the regulations with the intent to expand the range of allowable uses of reclaimed water and to increase the flexibility of the regulation's treatment process requirements. The revised Title 22 regulations are scheduled to be completed and available to the public in January of 1996.

The proposed revised Title 22 reclamation criteria are shown in Table B-2. The proposed revised reclamation criteria classify reclaimed water into four types, according to level of treatment: Undisinfected Secondary, Disinfected Secondary -23, Disinfected Secondary-2.2, and Disinfected Tertiary. Each of these reclaimed water types is defined in the proposed revised criteria by specific treatment processes that must be used and levels of coliform and turbidity that must be achieved.

The DOHS has also produced *Guidelines for Use of Reclaimed Water*, which apply to reclaimed water use areas receiving water which meets Title 22 Wastewater Reclamation Criteria. The guidelines focus on application and management specifications for various reclaimed water uses, including general use requirements, landscape irrigation requirements, impoundment requirements, and agricultural reuse area guidelines.[5] General requirements include: posting signs to inform the public in areas where reclaimed water is in use, confining reclaimed water to authorized use areas (setbacks may be required in some cases), marking reclaimed water distribution and transmission system piping to indicate that it contains reclaimed water, and other requirements designed to ensure that reclaimed water use does not affect public health.

The RWQCB is responsible for permitting of wastewater discharges, including water reclamation, within its region. The permitting process for a water reclamation project could involve issuance of waste discharge requirements (WDRs) and water reuse (reclamation) requirements, or of a master reclamation permit. WDRs are issued in accordance with the relevant regional water quality control plan, establishing water quality objectives in order to protect local beneficial uses. In conjunction with WDRs, the RWQCB (in consultation with the

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5 State of California, Department of Health Services, Environmental Management Branch, Guidelines for Use of Reclaimed Water, June 10, 1988

TABLE B-1: SUMMARY OF EXISTING TITLE 22 TREATMENT REQUIREMENTS FOR RECYCLED WATER

Potential Uses	Title 22 Criteria
Landscape Irrigation	
with High Public Contact	Bio-oxidation, coagulation, clarification, filtration, disinfection to limit coliforms to 2.2 MPN/100 m.
with Low Public Contact	Bio-oxidation, disinfection to limit coliforms to 23 MPN/100 ml.
Recreational Impoundments	
Non-Restricted	Bio-oxidation, coagulation, clarification, filtration, disinfection to limit coliforms to 2.2 MPN/100 ml.
Restricted	Bio-oxidation, disinfection to limit coliforms to 2.2 MPN/100 ml.
Landscape Impoundments	Bio-oxidation, disinfection to limit coliforms to 23 MPN/100 ml.
Industrial Uses	
Construction/Dust Control/Soil Compaction	Bio-oxidation, disinfection to limit coliforms to 23 MPN/100 ml.
Groundwater Recharge/Seawater Intrusion Barrier	This use shall be considered by DOHS and RWQCB on an individual case basis where the use of reclaimed water involves a potential risk to public health. Guidelines for this use have been proposed.
Cleaning, Dual Water System (Toilet Flushing and Landscape Irrigation), Fire Fighting, Wetlands Creation/Restoration	No criteria listed for any of these uses in existing Title 22. Currently, each of these uses is considered and criteria set by the RWQCB and DOHS on an individual case basis. Uses anticipated to be addressed in revisions to Title 22.

MPN = Most Probable Number

SOURCE: Environmental Science Associates, 1995; based on Title 22, Division 4, California Code of Regulations, 1978.

DOHS and any other interested parties) issues water reuse requirements to either the reclaimed water supplier, the reclaimed water user, or both. Water reuse requirements consist either of a requirement that the permittee comply with the statewide reclamation criteria, or case-specific requirements based on the statewide criteria and on the DOHS Reclaimed Water Guidelines.

TABLE B-2: PROPOSED RECLAMATION CRITERIA FOR USES OTHER THAN GROUNDWATER RECHARGE

Definition	Treatment Requirements	Reclaimed Water Uses: Irrigation	Reclaimed Water Uses: Impoundments	Reclaimed Water Uses: Cooling	Reclaimed Water Uses: Other
Undisinfected Secondary • Oxidized	**Coagulation Requirements:** NA **Filtration Requirements:** NA **Disinfection Requirements:** NA	**Allowable Uses:** • Orchards where reclaimed water does not contact the edible portion of the crop • Vineyards where reclaimed water does not contract the edible portion of the crop • Non food bearing trees • Fodder and fiber crops • Seed crops • Food crops with subsequent pathogen-destroying processing • Ornamental nursery stock and sod farms with restricted public access	**Allowable Uses:** • None	**Allowable Uses:** • None	**Allowable Uses:** • Sanitary sewer flushing
Disinfected Secondary-23 • Oxidized • Disinfected	**Coagulation Requirements:** NA **Filtration Requirements:** NA **Disinfection Requirements:** • ≤23 MPN total coliform/ 100 ml median concentration in last seven daily samples • May exceed 240 MPN total coliform/100 ml maximum concentration no more than once per 30 days	**Allowable Uses:** • All uses listed above plus: • Cemeteries • Freeway landscaping • Restricted access golf courses • Ornamental nursery stock and sod farms with unrestricted public access • Pasture for animals producing milk for human consumption • Nonedible vegetation in controlled access areas	**Allowable Uses:** • Landscape impoundments without decorative fountains	**Allowable Uses:** • Industrial or commercial cooling or air conditioning that does not involve the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist	**Allowable Uses:** • All uses listed above plus: • Industrial boiler feed • Nonstructural fire fighting • Nonpotable piping backfill consolidation • Soil compaction • Concrete mixing • Dust control on roads and streets • Road, sidewalk, and outdoor work areas cleaning

TABLE B-2: PROPOSED RECLAMATION CRITERIA FOR USES OTHER THAN GROUNDWATER RECHARGE (Continued)

Definition	Treatment Requirements	Reclaimed Water Uses			
		Irrigation	Impoundments	Cooling	Other
Disinfected Secondary-2.2 • Oxidized • Disinfected	**Coagulation Requirements:** NA **Filtration Requirements:** NA **Disinfection Requirements:** • ≤2.2 MPN total coliform/ 100 ml median concentration in last seven daily samples • May exceed 23 MPN total coliform/100 ml maximum concentration no more than once per 30 days	**Allowable Uses:** • All uses listed above plus: • Food crops where the reclaimed water does not contact the edible portion of the crop and the edible portion is produced above ground	**Allowable Uses:** • All uses listed above plus: • Restricted recreational impoundments • Publicly accessible impoundments at fish hatcheries	**Allowable Uses:** • All uses listed above	**Allowable Uses:** • All uses listed above
Disinfected Tertiary • Oxidized • Coagulated • Filtered • Disinfected	**Coagulation Requirements:** • In-line coagulation allowed **Filtration Requirements:** • ≤2 NTU daily average filter effluent turbidity • May exceed 5 NTU filter effluent turbidity no more than 5 percent of time • 10 NTU instantaneous maximum filter effluent turbidity **Disinfection Requirements:** Chlorine Disinfection: • "CT" value ≥300 mg-min/l at a modal contact time ≥90 min	**Allowable Uses:** • All uses listed above plus: • Food crops where the reclaimed water contacts the edible portion of the crop • Parks and playgrounds • School yards • Residential landscaping • Unrestricted access golf courses • Other non-prohibited irrigation uses **Additional Use-Related Treatment Requirements:** • Coagulant addition not required if filter influent turbidity ≤5 NTU at least 95 percent of the time	**Allowable Uses:** • All uses listed above plus: • Nonrestricted recreational impoundments **Additional Use-Related Treatment Requirements:** • Pathogen monitoring required unless separate sedimentation basin is provided as part of "conventional treatment." Monitoring may be stopped after two years with DOHS approval	**Allowable Uses:** • All uses listed above plus: • Industrial or commercial cooling or air conditioning that does not involve the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist **Additional Use-Related Treatment Requirements:** • Chlorine (or other biocide) shall be used to treat recirculating cooling water where cooling system mist could contact public	**Allowable Uses:** • All uses listed above plus: • Toilet and urinal flushing • Drain trap priming • Industrial process water that may contact workers • Structural fire fighting • Decorative fountains • Commercial laundries • Potable water pipeline consolidation • Artificial snow making • Commercial car washes **Additional Use-Related Treatment Requirements:** • Coagulant additional not required filter influent turbidity ≤5 NTU at least 95 percent of the time

TABLE B-2: PROPOSED RECLAMATION CRITERIA FOR USES OTHER THAN GROUNDWATER RECHARGE (Continued)

Definition	Treatment Requirements	Reclaimed Water Uses			
		Irrigation	Impoundments	Cooling	Other
	• ≤2.2 MPN total coliform/ 100 ml median concentration in last seven daily samples • May exceed 23 MPN total coliform/100 ml maximum concentration no more than once per 30 days • 240 MPN total coliform/ 100 ml maximum concentration Alternative Disinfection: • Five log reduction in MS-2 bacteriophage or polio virus in combination with filtration process • ≤2.2 MPN total coliform/ 100 ml median concentration in last seven daily samples • May exceed 23 MPN total coliform/100 ml maximum concentration no more than once per 30 days • 240 MPN total coliform/ 100 ml maximum concentration				

NA - Not applicable

SOURCE: DOHS, Notice of Public Availability of Changes to Proposed Regulations Regarding Wastewater Reclamation Criteria (R-24-93), May 9, 1995

Together, the WDRs and the water reuse requirements dictate the reclaimed water quality requirements, as well as when, where and how the reclaimed water may be used.

Instead of establishing water reuse requirements for each user, the RWQCB may issue a master reclamation permit to a supplier or distributor of reclaimed water or both. In addition to setting WDRs and water reuse requirements, a master reclamation permit requires that the permittee (1) establish rules regarding design, construction and use of reclaimed water facilities, (2) monitor facilities and use sites, and (3) submit a quarterly report to the RWQCB.

The RWQCB would issue Water Reclamation Requirements specific to the City of San Francisco's Recycled Water Master Plan. This order would be similar to Water Reclamation Requirements issued for other cities in the region.

California Legislature has issued a number of directives intended to encourage water reclamation in response to increasing demands upon limited state water supply. The most important of these are summarized in Table B-3.

GROUNDWATER

There are no federal laws regulating groundwater. In California, the Porter-Cologne Water Quality Control Act designates the SWRCB and RWQCB responsible for groundwater planning and protection programs. Under Porter-Cologne, the RWQCB is therefore responsible for issues involving groundwater contamination. In this arena, the RWQCB acts in conjunction with the State Department of Toxics Substance Control (DTSC), the DOHS, and with the federal EPA for superfund sites.

Groundwater planning in California is also authorized under the Groundwater Management Act of 1992 (AB 3030). This Act is permissive, rather than mandatory; it authorizes (but does not require) any local agency to prepare a groundwater management plan. Section 107653.7 of the Act lists plan elements that may be included which are as follows: control of saline water intrusion; identification and management of a wellhead protection program; regulation of the migration of contaminated groundwater; administration of well abandonment and well destruction program; mitigation of overdraft; replenishment of extracted groundwater; monitoring of groundwater levels and storage; facilitating conjunctive use; identification of well construction policies; construction and operation by local agency of groundwater cleanup,

TABLE B-3: LAWS, REGULATIONS AND POLICIES ENCOURAGING WATER RECLAMATION

Regulation	Directive	Agency	Citation
Water Reclamation Law (state)	Declares intent of state to take all possible steps to encourage water reclamation. Authorizes water suppliers to provide reclaimed water for beneficial use in accordance with uniform reclamation criteria.	SWRCB	Cal Water Code §13500-13556
Water Recycling Act (state)	Set state goals for beneficial reuse of water; requires retail water suppliers to ID potential uses, customers, and sources for reclaimed water in their service area.	SWRCB	Cal Water Code §13577
Urban Water Management Act (state)	Requires preparation, by each urban water agency serving > 3,000 customers or >3,000 acre-feet/year of water, of an Urban Water Management Plan, including a description of water reclamation and reuse activities in their service areas.	SWRCB	Cal Water Code §10631
Water Reuse Mandate (state)	Prohibits use of potable water for some uses	SWRCB	CA Water Code §13550-13556
Uniform Prohibition on Waste of Water (state)	Directs that water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use be prevented.	SWRCB	Article X §2, CA constit.

SOURCE: Environmental Science Associates, 1995; based on *Water Reclamation: A Summary of California Laws and Regulations*, Chapter 3, Peter MacLaggan, 1995

recharge, storage conservation, recycling and extraction projects; development of relationships with state and federal regulatory agencies; and the review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.[6] The Act also authorizes agencies to impose fees and assessments for the purpose of groundwater management, although such fees must be voter-approved.

6 Association of California Water Agencies, Ground Water Committee, AB3030, Groundwater Management Manual, Elements of a Groundwater Management Plan, April 1993

The federal Safe Drinking Water Act amendments of 1986 established the Wellhead Protection Program to protect groundwater sources of drinking water from contamination. This program is implemented by the DOHS.

The California Department of Water Resources (DWR) is responsible for developing standards for wells under California Water Code Section 231, first enacted in 1949. The most current statewide standards for water wells are contained in two bulletins produced by the State Department of Water Resources: SWR Bulletin 74-81, "Water Well Standards: State of California," published in 1981, and Bulletin 74-90, a supplement to 74-81, published in 1990. These standards are issued as minimum guidance for construction, alteration, maintenance and destruction of water wells, monitoring wells and cathodic protection wells in California. The SWRCB is responsible for adopting a model water well, monitoring well and cathodic protection well construction and destruction ordinance which implements DWR standards. All California cities and counties and some water agencies were required by California Water Code statutes of 1986 to enact local well ordinances by January 15, 1990.

In the City and County of San Francisco, the Department of Public Health, Bureau of Environmental Health Services Monitoring Well Section is responsible for well permitting. Water well construction and use permits are regulated under Part II, Chapter V (Health Code) of the City and County of San Francisco Municipal Code. The well permitting process requires submission of a plot plan of the well location, compliance with DWR constructions standards (74-81 and Draft 74-90), inspection by the Bureau of Environmental Health Services (or RWQCB or DOHS) of annular seal construction work, and other requirements as deemed necessary. These San Francisco water well permitting process regulations are currently (April 1995) in the process of revision.

DRINKING WATER

The Federal Safe Drinking Water Act is the nation's major law regulating drinking water quality, and is implemented by the U.S. Environmental Protection Agency. The Safe Drinking Water Act established primary and secondary drinking water regulations; implementation authority of this act has been delegated to the states.[7] Primary drinking water standards regulate contaminants that could potentially threaten public health, for example, organic chemicals or

[7] *The Safe Drinking Water Act as Amended by The Safe Drinking Water Act Amendments of 1986.* Public Law 99-339, December 1986.

heavy metals. Secondary drinking water regulations regulate characteristics of the water, such as taste, odor, and appearance, which do not affect public health, but rather the public welfare.

In California, the DOHS regulates drinking water and implements the Safe Drinking Water Act. The Department oversees public water systems such as San Francisco's water supply system. California regulations for domestic water quality and monitoring, including primary and secondary drinking water standards, are contained in Title 22, Division 4, Chapter 15 of the *California Code of Regulations* (also Health and Safety Code). These regulations are more rigorous than those in the federal drinking water regulations and so, supersede the federal standards in California.

The San Francisco Water Department (SFWD) is responsible for providing potable water to the City and County of San Francisco and to other customers in Alameda, Santa Clara and San Mateo Counties. The SFWD is responsible for assuring that the water supply system meets DOHS drinking water standards as it is delivered to individual users at the meter.[8] The San Francisco Department of Public Health works with the Water Department to provide Quality Control/Quality Assurance (QA/QC) through a program of monthly water quality monitoring at various points in the water distribution system. In addition, the San Francisco Department of Public Health works with the Water Department to respond to health-related customer complaints (non-health-related complaints are generally referred to the Water Department).[9]

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8 Dingman, Dave, Senior Chemist, San Francisco Water Department, 1995. Telephone communication with Amy Armstrong, ESA on March 8, 1995.

9 Anderson, Lorraine, Senior Environmental Health Inspector, San Francisco Department of Public Health, 1995. Telephone communication with Amy Armstrong, ESA on March 8, 1995.

APPENDIX C

AIR QUALITY EMISSION FACTORS, DATA INPUT AND MODELING RESULTS

APPENDIX C

AIR QUALITY EMISSION FACTORS, DATA INPUT AND MODELING RESULTS

TABLE 1: DUST AND EQUIPMENT EXHAUST EMISSION FACTORS - RWTP

Equipment Type (Operating Period, Power Level)	CO	NO_x	SO_x	PM_{10}
	Emissions Factors in Pounds per Day			
Excavator (6 hrs/day, 60%)	1.67	3.64	0.30	0.23
Backhoe (6 hrs/day, 50%)	0.43	2.01	0.13	0.14
Grader (6 hrs/day, 50%)	1.79	4.17	0.35	0.02
Loader (6 hrs/day, 80%)	0.57	1.89	0.18	0.17
Crane (8 hrs/day, 30%)	0.67	1.69	0.14	0.14
Idling Trucks (25 hrs/day,N/A)	0.29	0.15	Negligible	0.02
On-Road (Miles per Day /a/)	Emission Factors in Pounds per 1,000 Miles			
Haul Trucks (50 x 20 = 1,000)	24.53	27.36	Negligible	4.98
Commuting (20 x 40 = 800)	16.84	1.52	Negligible	0.24
On-Site Vehicles (5 x 20 = 100)	43.41	3.31	Negligible	0.24
Source (Max. Day = 50 Loads)	Construction Emissions in Pounds per Day			
Excavator	6.0	13.1	1.1	0.8
Backhoe	1.3	6.0	0.4	0.4
Grader	5.4	12.5	1.0	0.1
Loader	2.7	9.1	0.9	0.8
Crane	1.6	4.1	0.7	0.3
Idling Trucks	7.2	3.8	Negligible	0.5
Haul Trucks	24.5	27.4	Negligible	5.0
Employee Commuting	13.5	1.2	Negligible	0.2
Job-Site Vehicles	4.3	0.3	Negligible	<0.1
TOTAL	66.5	77.5	4.1	8.1

CO: Carbon Monoxide
NO_x: Nitrogen Oxides
SO_x: Sulfur Oxides
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Number of vehicles x Distance (round-trip) = miles

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 2: DUST AND EQUIPMENT EXHAUST EMISSION FACTORS - RESERVOIRS

Equipment Type (Operating Period, Power Level)	CO	NO_x	SO_x	PM_{10}
	Emissions Factors in Pounds per Day			
Excavator (6 hrs/day, 60%)	1.67	3.64	0.30	0.23
Backhoe (6 hrs/day, 50%)	0.43	2.01	0.13	0.14
Grader (6 hrs/day, 50%)	1.79	4.17	0.35	0.02
Loader (6 hrs/day, 80%)	0.57	1.89	0.18	0.17
Crane (8 hrs/day, 30%)	0.67	1.69	0.14	0.14
Idling Trucks (12 hrs/day,N/A)	0.29	0.15	Negligible	0.02
On-Road (Miles per Day /a/)	Emission Factors in Pounds per 1,000 Miles			
Haul Trucks (24 x 20 = 480)	24.53	27.36	Negligible	4.98
Commuting (20 x 40 = 800)	16.84	1.52	Negligible	0.24
On-Site Vehicles (5 x 20 = 100)	43.41	3.31	Negligible	0.24
Source	Construction Emissions in Pounds per Day			
Excavator	6.0	13.1	1.1	0.8
Backhoe	1.3	6.0	0.4	0.4
Grader	5.4	12.5	1.0	0.1
Loader	2.7	9.1	0.9	0.8
Crane	1.6	4.1	0.7	0.3
Idling Trucks	3.5	1.8	Negligible	0.2
Haul Trucks	11.8	13.1	Negligible	2.4
Employee Commuting	13.5	1.2	Negligible	0.2
Job-Site Vehicles	4.3	0.3	Negligible	<0.1
TOTAL	50.1	61.2	4.1	5.2

CO: Carbon Monoxide
NO_x: Nitrogen Oxides
SO_x: Sulfur Oxides
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Number of vehicles x Distance (round-trip) = miles

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 3: DUST AND EQUIPMENT EXHAUST EMISSION FACTORS - PIPELINES

Equipment Type (Operating Period, Power Level)	CO	NO_x	SO_x	PM_{10}
	Emissions Factors in Pounds per Day			
Backhoe (4 hrs/day, 80%)	0.43	2.01	0.13	0.14
Truck/Crane (4 hrs/day, 50%)	0.67	1.69	0.14	0.14
Compactor (4 hrs/day, 80%)	1.01	0.06	0.01	0.02
Paver (2 hrs/day, 100%)	0.67	1.69	0.14	0.14
Idling Trucks (1 hr/day,N/A)	0.29	0.15	Negligible	0.02
On-Road (Miles per Day /a/)	Emission Factors in Pounds per 1,000 Miles			
Haul Trucks (2 x 20 = 40)	24.53	27.36	Negligible	4.98
Commuting (10 x 40 = 400)	16.84	1.52	Negligible	0.24
On-Site Vehicles (2 x 20 = 40)	43.41	3.31	Negligible	0.24
Source	Construction Emissions in Pounds per Day			
Backhoe	2.8	12.9	0.8	0.9
Truck/Crane	1.3	3.4	0.3	0.3
Compactor	3.2	0.2	<0.1	<0.1
Paver	1.3	3.1	0.3	0.3
Idling Trucks	0.3	0.2	Negligible	<0.1
Haul Truck	1.0	1.1	Negligible	0.2
Employee Commuting	6.7	0.6	Negligible	0.1
Job-Site Vehicles	1.7	0.1	Negligible	<0.1
TOTAL	18.2	21.9	1.4	1.8

CO: Carbon Monoxide
NO_x: Nitrogen Oxides
SO_x: Sulfur Oxides
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Number of vehicles x Distance (round-trip) = miles

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 4: SCREENING MODEL EMISSIONS DATA INPUT /a/

Source	Emissions in Pounds per Day			
	CO	NO_x	SO_x	PM_{10}
RWTP Construction				
Equipment	24.2	48.6	4.1	2.9
Fugitive Dust	-	-	-	28.6
TOTAL	24.2	48.6	4.1	31.5
Reservoir Construction				
Equipment	20.5	46.6	4.1	2.6
Fugitive Dust	-	-	-	13.7
TOTAL	20.5	46.6	4.1	16.3
Pipeline Construction				
Equipment	8.9	20.1	1.4	1.5
Fugitive Dust	-	-	-	1.1
TOTAL	8.9	20.1	1.4	2.6

CO: Carbon Monoxide
NO_x: Nitrogen Oxides/Dioxide
SO_x: Sulfur Oxides/Dioxide
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Equipment + Truck Idling + Fugitive Dust

NOTE: Equipment emissions do not include off-site emissions (emissions from haul trucks, employee commuting, and job-site vehicles).

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 5: FUGITIVE DUST EMISSIONS (TSP) /a/

Source	TSP Emissions in Pounds per Ton
Excavation	0.058
Replacement	0.012
Truck Loading	0.037
Dump Truck Unloading	0.002
Wind Erosion	0.001
TSP TOTAL	0.11

	TSP Emissions in Pounds per Day	
RWTP Construction	1,000 yds/day x 1.3 tons/yd x 0.11 lbs/ton	143.0
Reservoir Construction	480 yds/day x 1.3 tons/yd x 0.11 lbs/ton	68.6
Pipeline Construction	40 yds/day x 1.3 tons/yd x 0.11 lbs/ton	5.7

/a/ TSP = Total Suspended Particulates.
PM_{10} approximately equals 20% of TSP.
Emissions Source: US EPA *AP-42, Fifth Edition*, January 1995 (Table 11.9-4 for bulldozing overburden in mining operations)

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 6: DUST AND EQUIPMENT EXHAUST EMISSIONS - RWTP

Distance from Construction Area	SCREEN2 Construction Emissions ($\mu g/m^3$) Concentrations Above Background			
	CO	NO_2 /a/	SO_2	PM_{10} /b/
Standard ($\mu g/m^3$)	23,000	470	655	50
Edge of Site	119	24	20	36
50 m.	100	20	17	30
100 m.	86	17	14	26
150 m.	76	15	13	23
200 m.	68	14	12	21
250 m.	62	13	10	19
350 m.	52	10	9	16
600 m.	33	7	6	10
850 m.	23	5	4	7

CO: Carbon Monoxide
NO_2: Nitrogen Dioxide
SO_2: Sulfur Dioxide
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Assumes 10% of $NO_x = NO_2$ near source
/b/ Assumes 8-Hour PM_{10} = 0.7 x 1-Hour PM_{10} and 24-Hour PM_{110} = 8-Hour $PM_{10} \div 3$

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 7: DUST AND EQUIPMENT EXHAUST EMISSIONS - RESERVOIRS

Distance from Construction Area	SCREEN2 Construction Emissions ($\mu g/m^3$) Concentrations Above Background			
	CO	NO_2 /a/	SO_2	PM_{10} /b/
Standard ($\mu g/m^3$)	23,000	470	655	50
Edge of Site	214	49	43	40
20 m.	191	44	38	36
40 m.	173	40	35	32
60 m.	158	36	32	29
80 m.	146	33	29	27
100 m.	136	31	27	25
125 m.	125	29	25	23
150 m.	115	26	23	22
200 m.	99	23	20	18
250 m.	85	19	17	16
300 m.	73	17	15	13

CO: Carbon Monoxide
NO_2: Nitrogen Dioxide
SO_2: Sulfur Dioxide
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Assumes 10% of $NO_x = NO_2$ near source
/b/ Assumes 8-Hour PM_{10} = 0.7 x 1-Hour PM_{10} and 24-Hour PM_{110} = 8-Hour $PM_{10} \div 3$

SOURCE: Geier & Geier Consulting, Inc., 1995

TABLE 8: DUST AND EQUIPMENT EXHAUST EMISSIONS - PIPELINES

Distance from Construction Area	SCREEN2 Construction Emissions ($\mu g/m^3$) Concentrations Above Background			
	CO	NO_2 /a/	SO_2	PM_{10} /b/
Standard ($\mu g/m^3$)	23,000	470	655	50
Edge of Site	1,032	233	162	71
10 m.	1,006	227	158	69
20 m.	873	197	137	59
30 m.	685	155	107	46
40 m.	521	118	82	35
50 m.	401	91	63	28
60 m.	315	71	49	21
70 m.	252	57	40	18
80 m.	206	47	32	14
90 m.	172	39	27	12
100 m.	143	32	22	9

CO: Carbon Monoxide
NO_2: Nitrogen Dioxide
SO_2: Sulfur Dioxide
PM_{10}: Respirable Particulate Matter with 10-micron diameter or less

/a/ Assumes 10% of $NO_x = NO_2$ near source
/b/ Assumes 8-Hour $PM_{10} = 0.7$ x 1-Hour PM_{10} and 24-Hour PM_{110} = 8-Hour $PM_{10} \div 3$

SOURCE: Geier & Geier Consulting, Inc., 1995

APPENDIX D

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Northwest Zone

Location	Altitude (ft.)	Comments	Preliminary Rating
Buena Vista	300-540	The site is the furthest east of the potential Northwest sites. Most of the park is kept as a natural environment, but the highest area was a parking lot and plant life is not well established in that area. Tennis courts are not high enough.	1
Grand View Park	640	The site is very small and very steep. Soil is mostly chert. Construction would almost certainly require levelling the entire site, and restoration would be impossible. The site is higher than is currently required for an operating reservoir.	0
Herbert Hoover Middle School	440-540	The site has a large asphalt recreation area. Altitude is very good for Northwest region users and could serve as an AWSS reservoir for Richmond and outer Sunset.	2
Interior Park Belt	400-700	The terrain is steep and heavily wooded. Constructing a reservoir would have a large impact on the site and might require a permanent change in a portion of the park's operation.	1
J.P. Murphy Playground	500	The park is small and located in a residential neighborhood but is mostly covered in hard top. Connection would be on the existing 7th Ave AWSS line; geologic stability of 7th Ave is the subject of concern but has not been studied.	1
Laguna Honda Hospital	400-520	Altitude is good for Northwest zone and would serve well as an AWSS reservoir, but the site's future is dependent on the scheduling and success of other bond issues. As a result it is not currently practical.	0
Lake Honda	380	The site is too low to serve the Northwest Zone w/o pumping and may be prohibited for environmental reasons. Connection would be on the existing 7th Ave AWSS line; geologic stability of 7th Ave is the subject of concern but has not been studied.	0

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Northwest Zone

Location	Altitude (ft.)	Comments	Preliminary Rating
Lincoln Park	200-360	The park is too low to irrigate the Northwest Zone w/o a booster system. Constructing a reservoir would impact the short term and possibly the long term operation of the golf course. Location has no usefulness as an AWSS reservoir.	0
Mount Olympus	560	The site is very small and the construction impact would be significant. The significance of the site would make the approval and public hearing processes very difficult if not impossible.	0
Presidio	0-360	The park is too low to irrigate the Northwest use areas w/o a booster system. Coordination problems in negotiating with the Federal government, especially while the administration of the site is in flux. Location has no usefulness as an AWSS reservoir.	0
Strawberry Hill	400	Elevation is insufficient to irrigate Lincoln Park and Presidio. Hill is in the middle of Stow Lake, and construction would require the temporary draining of the lake and demolition of the hill top.	0
Sunset Heights Park	680-700	A reservoir could probably be constructed under tennis courts or grassy area without impacting the park's established trees. The site is higher than is currently required for an operating reservoir, but would make an excellent site for an AWSS reservoir.	2
Tank Hill	520	The site is relatively small and located on the top and side of a hill. Construction would likely require removal of the hillside. Location	0
UCSF	400-700	The terrain is extremely steep and heavily wooded. The most appropriate locations are already developed. The site is state property.	0
USF	400	Elevation is insufficient to irrigate Lincoln Park and Presidio. Location is private property. Impact on the campus would be significant. Location has no usefulness as an AWSS reservoir.	0

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Northwest Zone

Location	Altitude (ft.)	Comments	Preliminary Rating
Youth Guidance Center	540-600	Construction would be difficult unless coordinated with the construction of a new facility which depends on the scheduling and success of other bond issues. Altitude is good for Northwest users and would serve well as an AWSS reservoir.	0

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Southwest Zone

Location	Altitude (ft.)	Comments	Preliminary Rating
Aptos Middle School/Aptos Playground	300	The site is too low to serve all of the Southwest region as it is currently zoned. The site is on the Ocean Ave AWSS line, but with only one east-west line in the area, operation scenarios would be limited. Could also serve eastside users.	0
Balboa Reservoir	300	The site is too low to serve all of the Southwest region as it is currently zoned. If the reservoir's primary purpose is to feed Sunset users, a site at the west end of the Ocean Ave line would be more appropriate. The site is on the Ocean Ave AWSS line, but with only one east-west line in the area, operation scenarios would be limited. Could also serve eastside users.	0
Brooks Park	460	Could serve both Southwest and Southeast users, but the site is small and uneven. Construction impact would probably require a change in the nature of the park.	0
J.P. Murphy Playground, Grand View Park, Sunset Heights Park, Herbert Hoover Middle School, Laguna Honda Hospital, Youth Guidance Center	500-700	These locations are higher than is required for routine uses in the Southwest region, but could serve the Southwest if incremental pumping costs prove to be negligible.	1
Lake Honda	380	The site may be prohibited for environmental reasons. Connection would be on the existing 7th Ave AWSS line; geologic stability of 7th Ave is the subject of concern but has not been studied.	0
Lincoln High School/McCoppin Square	300-420	Site is centrally located to irrigate the Southwest and house a lift station to most Northwest reservoir sites.	2
Merced Heights	300	The site is too low to serve all of the Southwest region as it is currently zoned. Could serve both Sunset and eastside users. Site has sufficient blacktopped and grassy areas for a moderate sized reservoir. An extension along Brotherhood would improve the flexibility of this site.	0
Mount Davidson	700-900	Very steep and heavily wooded. Extremely high altitude for an operating reservoir.	0

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Southwest Zone

Location	Altitude (ft.)	Comments	Preliminary Rating
Ocean View Recreation Center	320-380	The site would work be more attractive if an extension is constructed along Brotherhood to Alemany. With that extension it could be filled from Ocean Ave and feed by gravity to Brotherhood. Could serve both Southwest and Southeast users.	1

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Southeast Region

Location	Altitude (ft.)	Comments	Preliminary Rating
Aptos Middle School/Aptos Playground	300	The site is on the Ocean Ave AWSS line, but with only one east-west line in the area, operation scenarios would be limited. The site could serve both Sunset and Southeast users, but it is too low to serve all of the Southwest region as it is currently zoned. If the reservoir's purpose is to feed eastside users, a site at the east end of Ocean Ave would be more appropriate.	0
Balboa Reservoir	300	The site is on the Ocean Ave AWSS line, but with only one east-west line in the area, operation scenarios would be limited. The site could serve both Sunset and Southeast users, but it is too low to serve all of the Southwest region as it is currently zoned.	1
Bay View Park	200-400	The site is little used by the public and is kept mostly as a natural environment. The environmental approval process could be difficult. The site is on the fringe of its service area.	0
Bernal Heights Park	300-400	The site is close to existing lines and is centrally located to its anticipated service area.	2
Brooks Park	460	Could serve both Southwest and Southeast users, but the site is small and uneven. Construction impact would probably require a change in the nature of the park.	0
Diamond Heights - Glen Canyon Park, Glen Canyon Rec Center, George Christopher Playground, ...	300-500	All of these sites are far removed from existing lines and users, and the twisting roads in the region give few attractive line routes. Most sites are not at all practical, but some may merit further consideration.	1
Luther Burbank Middle School	340-400	The school has large blacktopped areas, some of which are in poor repair. At the foot of McLaren Park, it is a natural location to receive water from across town and house booster pumps for irrigating the park and filling an AWSS reservoir.	2
McLaren Park	300-500	The park would be a good location for AWSS storage but is high for projected eastside users. Energy costs will impact the site's potential.	2

ANALYSIS OF POTENTIAL RESERVOIR LOCATIONS
Southeast Region

Location	Altitude (ft.)	Comments	Preliminary Rating
Merced Heights	300	The site is too low to serve all of the Southwest region as it is currently zoned. If the reservoir's primary purpose is to feed Southeast users, a site at the east end of the Ocean Ave line would be more appropriate. Could serve both Sunset and Southeast users. Site has sufficient blacktopped and grassy areas for a moderate sized reservoir. An extension along Brotherhood would improve the flexibility of this site. The site is remote from Ocean Ave.	0
Ocean View Recreation Center	320-380	The site could only serve as a gravity reservoir if an extension is constructed along Brotherhood to Alemany. With that extension it could be filled from Ocean Ave and drained to Brotherhood. Could serve all Southwest and Southeast users.	1
Potrero Hill Rec. Center	280	Altitude is relatively low; the location, therefore, has no usefulness as an AWSS reservoir and can serve only a limited region for reclaimed water consumption.	1
Visitacion Valley High School	200-300	Feeding the site from the Sunset would entail a circuitous route requiring many new lines. The elevation is low, limiting the region the site could serve, and it is located on the fringe of that region.	0

RECREATION AND PARKS DEPARTMENT FACILITIES TO BE INVESTIGATED

Site	Approximate Altitude	Free Area	Potential Usage	Comments
Bay View Park	200-440		Reservior	
Brooks Park	440		Reservior	
Buena Vista Park	300-540		Reservior	
Glen Canyon Park	240-440		Reservior	
Grand View Park	640		Reservior	
Interior Belt Park	400-700		Reservior	
J.P. Murphy Playground	500		Reservior	
Lincoln Park	200-360		Reservior	
McLaren Park	360-500		Reservior	
Mount Davidson	700-920		Reservior	
Mount Olympus	560		Reservior	
Sunset Heights Park	680-700		Reservior	
Tank Hill	520		Reservior	
Twin Peaks	700-800		Reservior	

RECREATION AND PARKS DEPARTMENT FACILITIES TO BE INVESTIGATED

Site	Approximate Altitude	Free Area	Potential Usage	Comments
Golden Gate Park	20-400		Pump Station	
Grattan Playground	340		Pump Station	
Lincoln Park	200-360		Pump Station	
McCoppin Square	340		Pump Station	
Merced Heights Playground	300		Pump Station	
Ocean View Rec Center	320-380		Pump Station	
Presidio Parkway	160-200		Pump Station	
Stern Grove (inc. Parkside, Larsen, and Pine Lake	80-260		Pump Station	

ZONE	SITE	USAGE	ALTITUDE AT TAKE-OFF	ALTITUDE POINT OF USE
Northwest (Richmond)				
	Presidio	Irrigation	140	360
	Lincoln Park	Irrigation	190	360
	Washington HS	Irrigation	240	240
	Residential	AWSS	NA	up to 240
Golden Gate Park				
	Golden Gate Park	Irrigation	200	up to 400
West (Sunset)				
	Suset Blvd	Irrigation	80-180	180
	Great Hgwy	Irrigation	< 20	< 20
	Stern Grove	Irrigation	100	180
	South Sunset Plgd.	Irrigation	80	80
	Residential	AWSS	NA	up to 200
Southwest (Lake Merced)				
	Lake Merced	Irrigation	60	100
	SF State		60	180
	SF Zoo		20	60
	Residential	AWSS	NA	up to 200
Southeast				
	McLaren Park	Irrigation	360	500
	Candlestick	Irrigation	20	< 20
	CalTrans	Industrial	20	60
	PG&E	Industrial	< 20	< 20
	Hunter's Point	Irrigation	20	100
	Mission Bay	Irrigation	< 20	< 20
	Residential	AWSS	NA	up to 200

APPENDIX E

EIR AUTHORS AND CONSULTANTS; ORGANIZATIONS AND PERSONS CONSULTED

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